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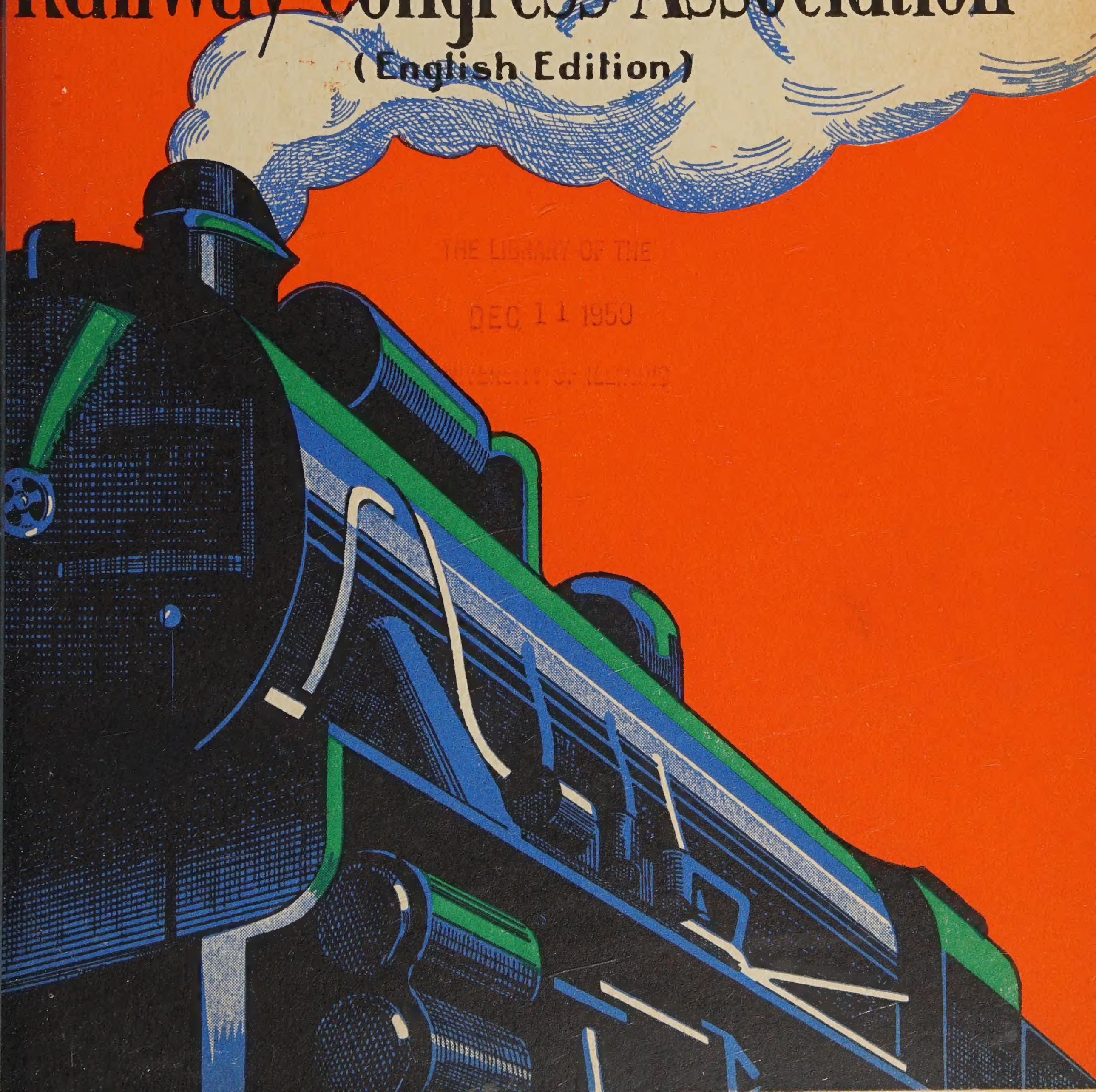

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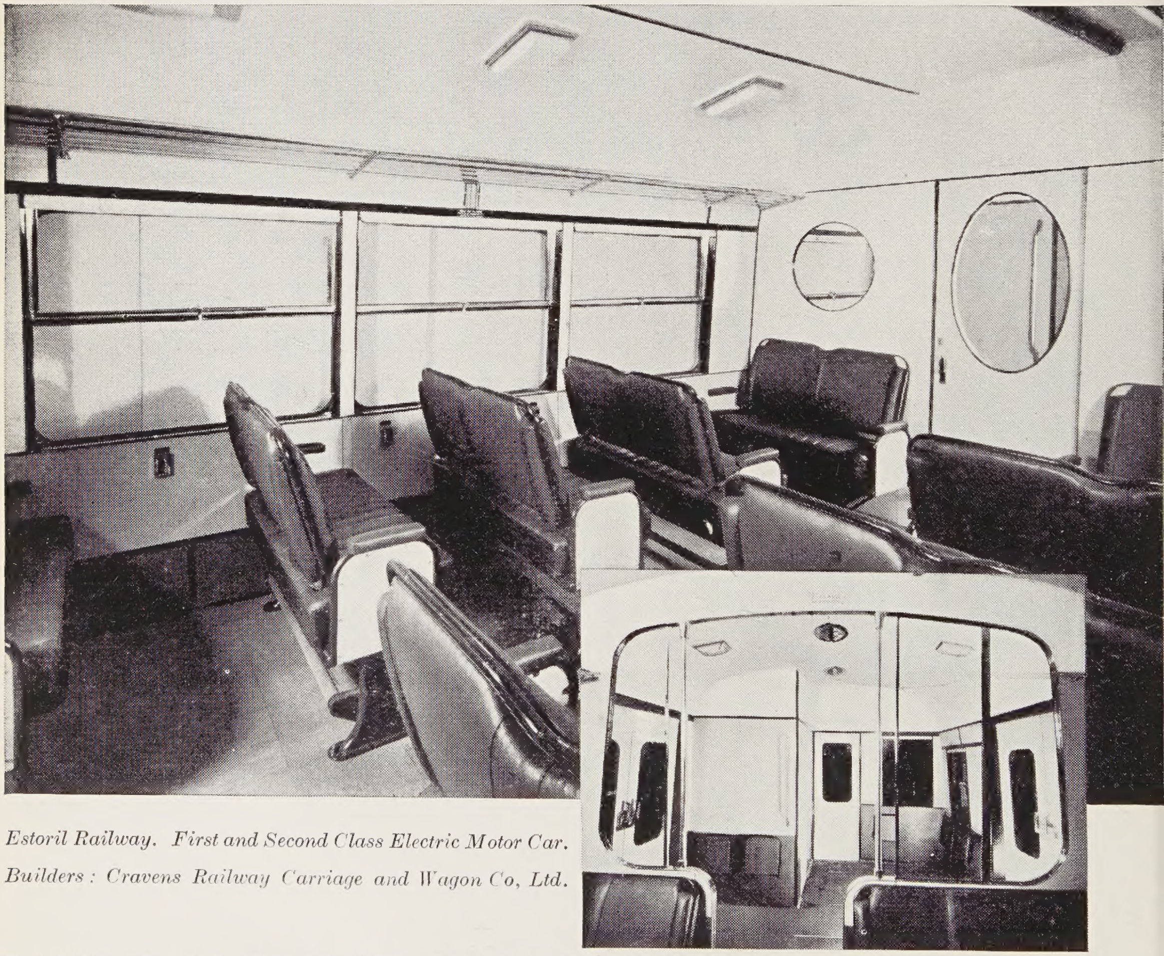

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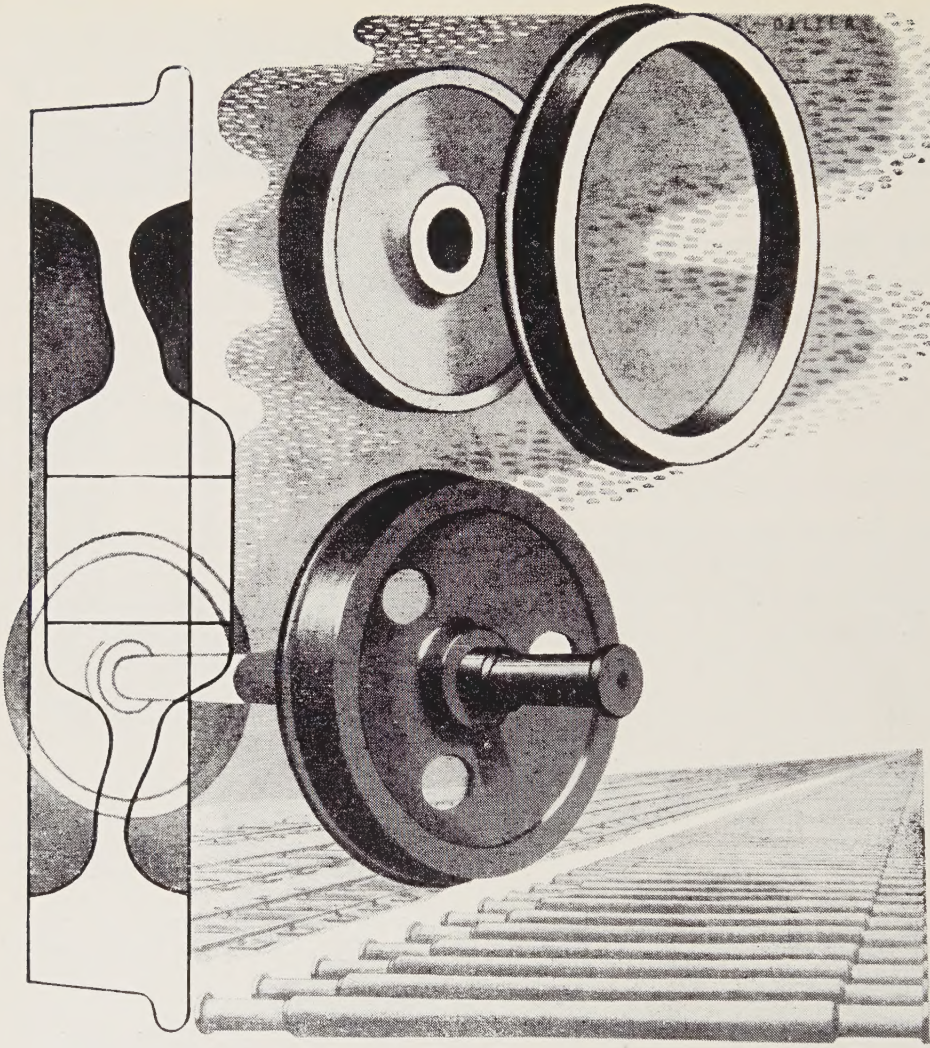

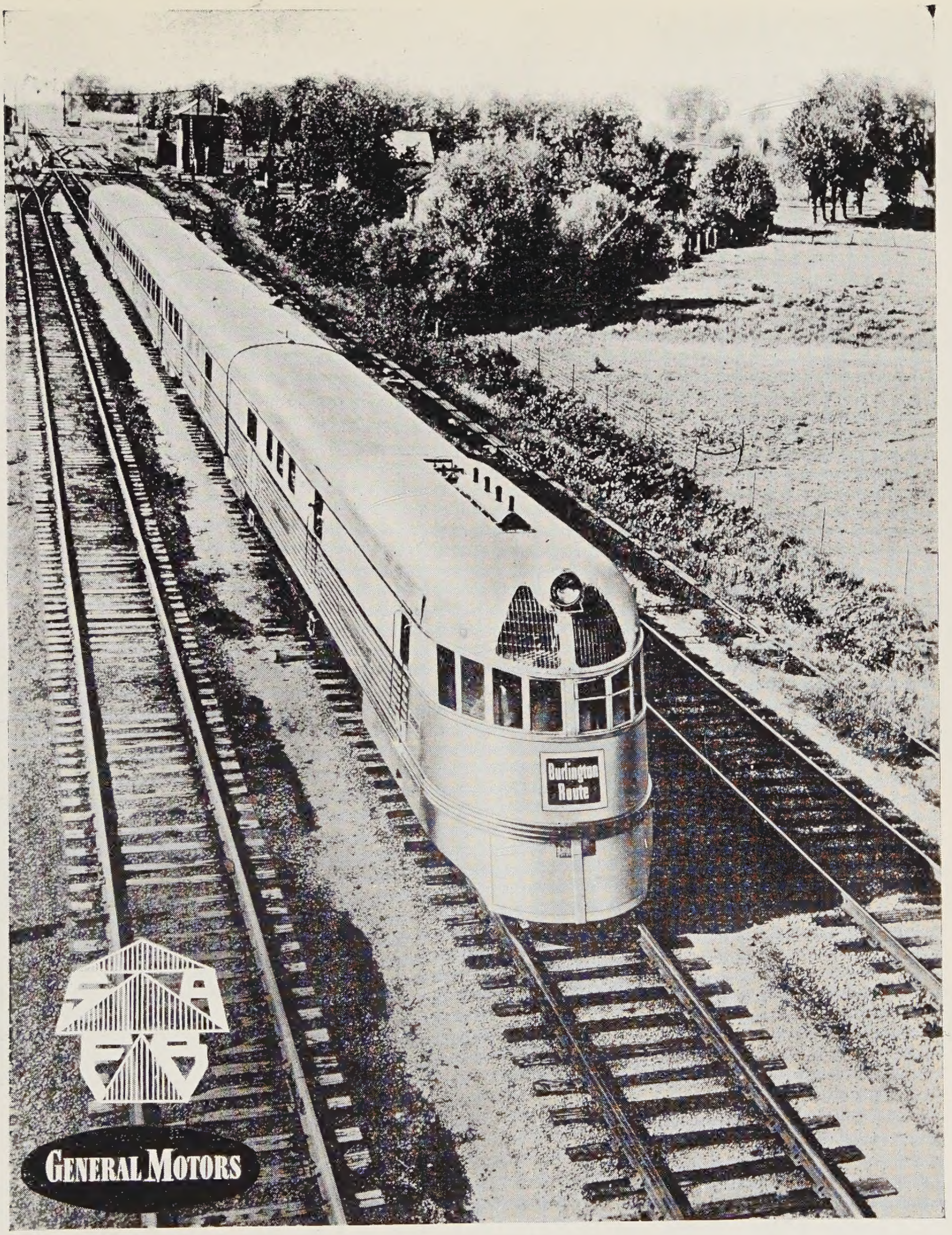
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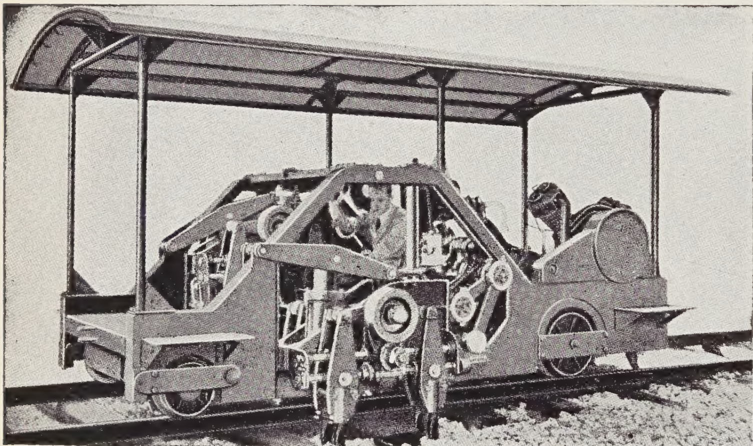

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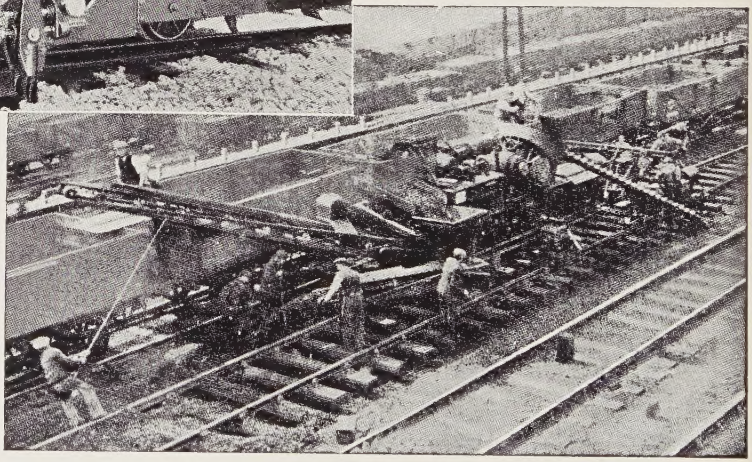

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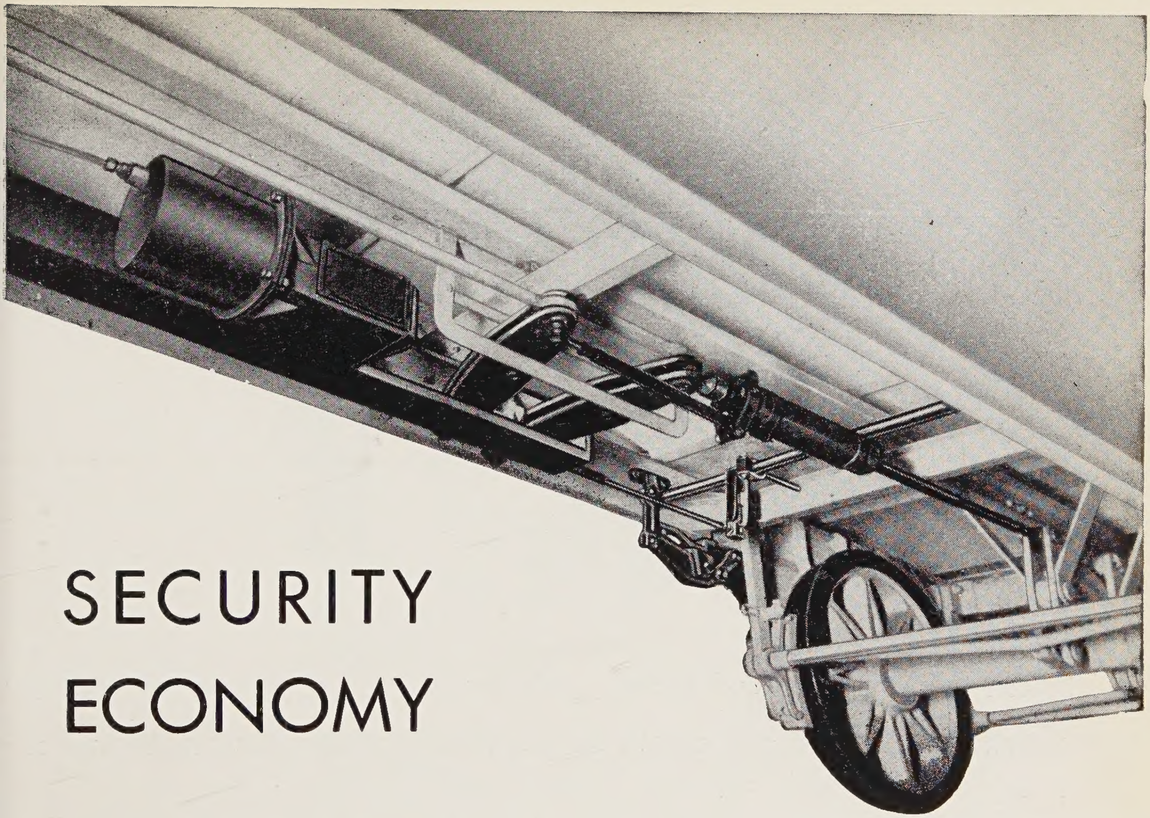

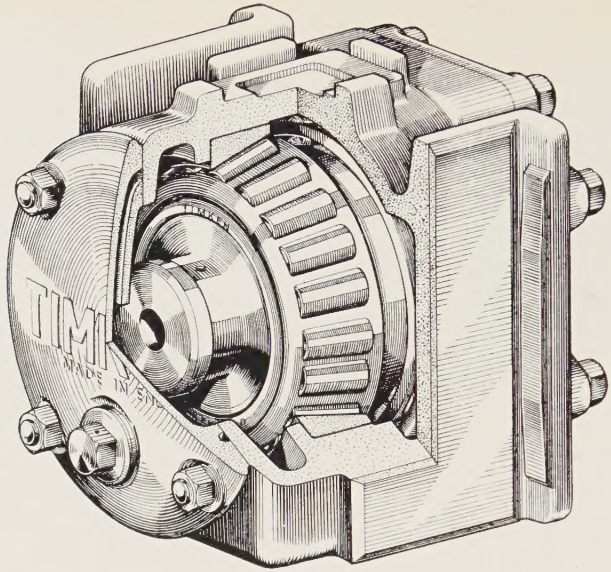

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Bulletin of the International Railway Congress Association

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MONTHLY BULLETIN

OF THE

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An edition in French is also published.

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BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[385 (44) & 656 .261 (44)]

... and the Railway shall live.

A few reflections on the future of the French Railways and the problem of terminal transport, (*)

by M. GUIBERT,

Ingénieur en Chef au service Commercial de la Société Nationale des Chemins de fer français.

This Conference touches upon a certain number of problems which have been discussed in detail by the XVth Session of the Congress, in September 1950, so that the following extracts may prove of interest :

Gentlemen,

Since 1947, the disquieting shadow of an operating deficit has once more darkened the activities of the French Railways. Although this deficit has not yet reached the proportions of those of immediate prewar days, it would seem to be approaching them rapidly. And so, once again the question, so distasteful to French opinion arises: is the railway an outmoded method of transport, superseded by its competitors ?

Even when we remember how much of this deficit — a considerable proportion in actual fact — is due to the government decisions, on account of their social policy, to keep the passenger rates below the actual costs, the railway, as at present operated and in the situation in which the laws and regulations applying to it, have placed it, no longer appears able to pay its way.

Is the railway therefore doomed?

Consequently many of the well informed have thought it their duty to denounce the old fashioned and restricted character of the railway, and nowadays in the railway press it is frequently alluded to as this « tired old woman » in contrast with the « well set up youths », the motor vehicles. The remedy advised is a clean sweep of the brush to get rid of this out dated method of transport.

Gentlemen, the arguments which the eminent representatives or ardent defenders of automobile interests put forward in a partisan press every day will doubtless not surprise you, as the polemics between rail and road is one of the maladys of modern times. But the French railwaymen are very sensitive to it. It is not so much that they are annoyed by the appreciations of their adversaries whose doubtful styles betray in spite of everything a firm conviction. Nor is it that they feel themselves menaced by the said clean sweep. But, being passionately devoted to their work and their profession (for which they are reproached or

(*) Extracts from a Conference recently given in London before the Institute of Transport and the British Section of the « Société des Ingénieurs civils de France ».

congratulated as the case may be), they cannot feel happy about the operations prescribed by such surgeons. And above all they are more than ever convinced of the vitality of their industry.

I would like to speak to you today about the reasons for this conviction. The method which I shall employ will not be based upon the often debatable and always disputed figures of additional receipts or savings to be expected from certain reforms. It will rather consist in calling attention to the real possibilities of the railway, compared with its road competitors: though this may seem a less tangible method, I think in the end it will be found to be more thorough, more solid, and consequently more effective.

The railway industry must not be confounded with its attribute of public service.

Right away I must make a distinction between the railway industry proper, its technique, its organisation, its commercial possibilities, and its attribute of « public service » which it has been given by legislative and regulative machinery, which, except for unimportant details has remained unmodified for over a century in spite of the evolution of transport and the complete disappearance of the railway monopoly. Here it should be recalled that until the new co-ordination measures became law (and their scope is still very indefinite), the State has allowed motor transport to develop, largely on basis of individual operation and after being a feeder to the railway it has become a dangerous competitor. Undoubtedly, the Government have endeavoured to regulate motor transport to some extent by arbitrary decrees, but ultimately these have been of greater benefit to the hauliers themselves than to the railway. At the same time the State left the railway bound by its obligations as a monopoly-holding public service, and had itself to meet the cost of this planned unbalanced state. To change this situation, the railway demanded, not the suppression of competition, but its normalisation, and it is of the opinion that such normalisation can only result from an equitable « sharing of the burdens ».

The adversaries of the railway have gone about misrepresenting this demand in two different ways. The first way is to make a voluntary confusion of the equalisation of the *legal burdens*, which is alone demanded by the railway, with the ridiculous equalisation of the *technical operating* conditions. Thus the railway could be taunted with the fact that when it replaced the stage coaches, it was not required to « change locomotives every 20 km like the coaches changed horses... » [1]. The second way is to object that the demand of the railway would impose upon the road a legal system that is already superannuated and quite impossible for modern economy. In actual fact, the railway, in making this demand, does not ask for any specific burdens to be laid on the different methods of transport. It is the business of the government to decide if any guarantees of public service shall be imposed upon the more or less extensive activities of the different transport undertakings. But when the considerable importance of road transport is considered, there does not seem to be any valid reason, if there is to be normal rail-road competition, for requiring guarantees or imposing legal obligations of a completely different nature according to whether the traffic is carried by rail or by road.

Why, for example, should the S. N. C. F. be responsible for the full costs of maintenance and renewal of its permanent way, while it is an undoubted fact that the large transport lorries, undisputed competitors of the railway, do not pay their share of the cost of maintaining the roads, and consequently are to this extent receiving a considerable indirect subsidy? There is no gain saying the fact that a 15 ton diesel

(1) M. LAMY, *Bulletin des Transports*, January 1950.

lorry only paid on the average in 1949, in the way of fuel taxes, 0.35 fr. per gross tonne/kilometer, whilst a 2 ton lorry paid 1.10 fr., and the total product of the tax on fuels certainly did not exceed (in fact in our opinion was very much lower) the share of the road costs which might reasonably be attributed to the motor vehicle.

Why is the railway compelled to accept all the traffic offered, whatever its origin and volume and whatever the extent to which the load will upset each service, whilst the road haulier is completely free to choose his traffic ?

Why should the railway be bound to respect the published and government approved rates, whereas road hauliers can *in practice* offer any rates they choose, since no professional or other organisation has to date succeeded in getting any tariff regulations respected ?

It will doubtless be argued that the railway industry, being necessarily concentrated, should, on account of its high capacity, be submitted to a control which the individual character of the road transport undertaking makes much less necessary. The railway is not objecting to being controlled, but is merely asking that its commercial possibilities shall not systematically be made inferior to those of its competitors. It is just as possible to control an undertaking which is operated with the object of paying its way, without any concern as regards public service, as one that is operated as a public service, without any concern about paying its way.

This is then the crux of the problem of co-ordination, which is much more as between public services and private undertakings than as between railway and road. New regulations are now being framed. Let us hope that the public authorities will succeed on this occasion in satisfying this principle of equalisation of the burdens if they desire that the railway shall occupy its proper place. If this satisfaction is not given, the fact must still be admitted that the railway organisation, in spite of the loss of its monopoly, and *simply because it is the railway,* has special duties towards the community : let those concerned then accept the fact of an operating deficit and not incriminate its management and domestic qualities.

The qualities of railway transport compared with those of its road competitor.

Assuming this problem as solved (a detailed examination of which would lie outside the scope of this conference), I will now consider whether railway transport, under normal conditions of competition, should be judged inferior or superior to road transport.

Rail transport, it is said, is an old technique. Let the young techniques, like road transport, have their day. What is meant by this ?

I do not think we must waste time in considering the expression « young technique » from a purely chronological point of view. The merit of the automobile does not lie in the fact that it was invented after the railway. In this connection, it would in fact be hard to decide which did indeed come first. The steam engine originally had the technique of the automobile (the « fardier » of Cugnot tried out in Paris in 1770, the road engines of Trevithick and Vivian tried out in England in 1798, the steam coach of the Englishman, Julian Griffith, in 1821...) and, on the other hand, internal combustion engines, which together with pneumatic tyres, explain the prodigious development of the automobile, were not at first limited to use on the roads. As early as 1888, i.e. immediately after the first Daimler « petrol victoria » (1886) [1], the Cannstadt tramway near Stuttgart was equipped with the same Daimler explosive engine, followed at a much later date by our modern petrol railcars. In 1912 a Diesel locomotive (Sulzer) of 1 200 HP, was used by the Prussian-Hessian State Railway [2], and was the forerunner of the

(1) *A travers les Chemins de fer,* by Falaize and Girod-Eymery.

(2) *Ditto.*

powerful Diesel locomotive of today, of which a great development in the future is to be expected, both for hauling trains and for shunting. As for electric traction, apart from vehicles running on batteries, of limited use (the first such vehicle was that of Jeantaud in 1904), the use of electric current for road traction with trolley-buses (1904, France) came long after the tramways (1881, Germany) and the electric trains (1885, U. S. A.).

But let us leave the calender aside, and deal with youth as an intrinsic quality. In reality, youth is both a virtue and a defect. *Larousse* defines youth as : « He whose thoughts and conceptions are immature » or again « he who retains the vigour and charm of youth.... ». I will not dwell on the first definition — although certain mischievous minds reproach to the organisation of transport by road precisely this defect of immaturity — and consider the second which is precisely that defended by all the road fans. The youngest technique is thus that which has the greatest vital force because it represents « progress ». Undoubtedly from many points of view the automobile seems to represent « progress », but we must not be too quick to draw conclusions, and we will pursue a little further our comparision of the two techniques. In order to do this, I propose making a new and essential distinction between :

— the main operation of transport, i.e. the traction by rail or by road over a given journey of a vehicle loaded with passengers or goods;

— the supplementary transport characteristics (handling, packing up goods, conditions as regards collection and delivery to warehouses or to clients premises, etc.) the importance of which must not be overlooked, as from the user's point of view they may alter the whole picture.

Traction.

Let us first consider the operation of traction. We will study this over certain distances, of at least 100 km (62 miles) for example, as it is over such distances that there is competition, short distance door to door transport (with the exception of bulky traffic and traffic to private sidings) being the appanage of the automobile.

The essential qualities for traction are economy, speed and safety.

Safety. — I will not dwell upon safety, since the advantages of the railway from this point of view are too well known. The number of passengers killed per thousand-million passenger kilometres was in 1938 : 1 530 by air, 71 by road, and 0.55 by rail. In 1947, these figures were 63 by air, 108 by road, and 0.64 by rail (1). Do you know that, if the statistics of the Ministry of Justice and Civil Affairs (2) are to be believed, if the future of a Frenchman, was to be predicted at his birth, he has a greater chance of being murdered than of being killed accidentally on the railway. And do not run away with the idea that there are more murderers in France than elsewhere...

In the case of goods traffic, no road statistics are available for a comparison of the relative safety of road traffic and railway traffic. But the reputation of the railway remains the superior, especially when its obvious solvency and the certainty that values confided to it will be returned are taken into account. I think it interesting to point out that in 1948 the value of the indemnities paid for loss, delay or damage was only 1.6 % of the total receipts for goods traffic, in spite of the high level of responsibility accepted by the railway.

Speed. — As for rapidity, and remaining within the framework of the comparison we are making (i.e. excluding short distan-

(1) The figures for air travel are taken from the Bulletin of the *Veritas Bureau*, those for the road from the Statistics of the Ministry of Justice, those for the railway from the statistics of the S. N. C. F.

(2) Probability of being murdered : 0.15 %; probability of being killed in a railway accident : 0.11 %.

ces), the position of the railway, with regard to most traffics, is the better.

In the case of passenger transport, at the present time the French Railways steam trains on the important services run at an average speed of more than 90 km/h (56 m.p.h.) and the electric trains and fast railcars at more than 100 km/h (62 m.p.h.); speeds which there is no question of asking of the motorcar, not even of private cars, at the present time, although such averages are possible to the privileged few with high powered vehicles...

In the case of goods transport, the lorry has the reputation of being the fastest. Without doubt, we admit it is able to carry out urgent transports with exceptional speed, even over long distances. But as far as ordinary routine transport is concerned, the matter is much more questionable.

In order to make an exact comparison between the two methods of transport, two precautions must be taken :

- the first is to take in account the fact that the railway only transports rapidly those goods which require it (as it happens, it is these goods which are usually stolen by the road), so that it has two different speed regimes to offer, ordinary and accelerated. Logically therefore it is the accelerated regime which should be used for our comparison;
- the second precaution is to compare the comparative delays, bearing in mind that the railway is obliged to accept and transport on demand every consignment offered, whereas the road haulier often only accepts — and more particularly will only transport — goods when he has sufficient freight and vehicles available.

Which goes to prove that the railway is the best when it considers it useful to make the necessary effort.

For concrete examples mention may be made of the rapid transit provided in the case of early vegetables from the Rhone Valley to the Paris region (Cavaillon, 10 a.m. — Paris, 11 p.m.) or fish from Boulogne (Boulogne, 1 p.m., day A — Limoges, 3 a.m., day B; Boulogne, 4 p.m., day A — Turin, 9 p.m., day B, etc.), or early vegetables from Perpignan (Perpignan, 10 p.m., day A — Brussels, 3.35 a.m., day C). These *regular* transports run the whole length of France in less than 24 h.

Economy. — There remains economy, the quality which in spite of everything is the most important consideration in operating transport. In the fundamental field of the cost price, the railway outstripped the stage coach; has the railway in turn now been outstripped by the automobile?

I am going to give you a few figures which will give you a picture of the most up to date railway technique (electric traction between Paris and Bordeaux : 579 km (360 miles) as compared with the most up to date road technique (15 ton Diesel lorry over the same route). Naturally my comparison is based on the assumption that the two methods of transport are used under the same conditions and I have therefore eliminated the artifical phenomena of just taking the cream of the traffic. Supposing in each case a user coefficient (ratio between the tonnes/kilometres transported and the tonnes/kilometres offered) equal to 0.70, the cost of a 15 ton wagon between Paris and Bordeaux is 1.79 fr. and that of the 15 ton lorry 8.17 fr. The railway figure is based on the accounts of the S. N. C. F. The road figure is taken from an investigation carried out by the « Fédération Nationale des Transports Routiers » [1].

I know very well that the cost figures of the S. N. C. F., which are not open to public inspection, are systematically suspected of partiality by the adversaries of the railway. It is possible however to check the accuracy of those I have just quoted. The total cost of the goods traffic in 1948, including the financial charges, amounted to 187 thousand million francs,

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[1] Note E G 10 of 21st December 1948 for the « Conseil Supérieur des Transports ».

145 thousand millions being for full loads. These 145 thousand millions correspond to 39 467 millions of useful tonnes/kilometres, so that a simple division gives 3.68 fr. per useful tonne/kilometre. But all the transport is included in these results, both that over small distances (the average mileage for wagons in 1948 was 258 km = 160 miles) and that hauled by steam.

There is nothing to be surprised at therefore under these conditions if the cost of railway transport using electric traction between Paris and Bordeaux is 1.79 fr. At 200 km (124 miles) this figure would be about 2 fr. All these figures, which any impartial critic can easily check, show that the cheapest road technique, according to the distance, but always omitting the short distances, costs 4 to 5 times more than the best railway technique.

How does this compare with the ratio when the first railways superseded the stage coaches in 1850. Lacking precise details concerning the cost price, we will base our opinion on the rates, which at that period of intense competition, should definitely reflect the average costs : the rate for transporting passengers by road then varied from 11 centimes (« imperial » and « rotonde » stages) to 16 centimes (stage coach coupé) and 20 centimes (mails) whereas the railway rates varied from 5.5 centimes (3rd class) to 7.5 centimes (2nd class) and 10 centimes (1st class) (1).

In the case of goods, the ordinary road transport cost 0.25 fr. in about 1840, 0.20 fr. in 1865, 0.30 fr. in 1879, while the average charges on the railways varied from 7.65 centimes in 1855 to 5.68 centimes in 1883 (2). To give a more concrete example, it costs 14 fr. to transport a hectolitre (2.75 bushels) of corn between Marseille and Vesoul in 1847 by road and 3 fr. by rail in 1853 (3).

Consequently the ratio between the road and railway rates on the average and *in order of magnitude* was 2 for passengers and 3 to 4 for goods.

Even taking it that the railway rates, then definitely under trial, must have been on the average above their costs, it may be concluded from the foregoing figures that the efforts the railway has made for more than a century to modernise its technique has enabled it to *retain* if not extend the *margin* it had at the beginning over the stage coaches, and the mails, in spite of the considerable leap forward road technique has made with the inception of the automobile.

The progress of the automobile is apparent every year in France in the excellent Motor Shows. There are no locomotive shows. However the latter, discretely but surely, has followed the path of progress, not by annual bounds like the automobile, but by greater leaps forward at longer intervals, explainable by the long amortisation period of railway engines. There is already a long way between the Rocket of STEPHENSON (1829) and the *Crampton* (1849), and between the *Mallet* (1878) and the *Atlantic* (1900) and *Pacific* (1910) locomotives, and finally between the latter and the modern steam engines (*Super-Pacific, Mikado, Mountain*), electric (CC) or Diesel-electric (2C2 + 2C2) engines. And the permanent way and signalling installations have followed the same continuous progress, the last example of which, the centralised traffic control at Dijon, is not the least remarkable. In this way railway traction has retained its lead...

Is not this fact more reassuring for the future of the railway than any speculations upon the operating balance sheets of the S. N. C. F. ?

It is found again, moreover, when comparing in respect of the two methods of transport, essential factors which are not the costs themselves but have a direct bearing upon them, such as the fuel consumption, the labour output, the consumption of materials per unit of traffic.

Everyone knows that resistance to rolling is much lower on the railway than on the

(1) *Le Chemin de fer,* by A. PICARD, p. 173.

(2) *Ditto,* p. 182.

(3) Lecture by M. JOUFFROY to the Paris Faculty of Letters in 1943.

road, thanks to the nature and profile of the track. If account is taken at the same time of the mechanical resistance known as « on the level » and aerodynamic resistance, the power consumed by these resistances at 50 km/h (31 m.p.h.) in calories per tonne/kilometre offered amounts to :

— 12 for an ordinary slow goods train;
— 77 for a 10 t Berliet lorry.

But it is necessary to combine this output of power with that of the traction engine (drawbar pull) taking into account the different sorts of motors (steam, Diesel, electric) used to a different extent by the two methods of transport. The drawbar pull of the steam engine (ratio between the amount of power at the drawbar and the amount of power consumed at the source) is only 5.4 % on the average with present technique, but reaches 10 % in the case of the most perfected engines; it is 25 % on the most perfected Diesel locomotive, 32 % on present day Diesel lorries, and 59 % for electric traction, the latter figure taking into account the percentage of electric power of hydraulic origin really used by the electric traction of the S.N.C.F. in 1938 (1).

Combining this drawbar pull with the resistance to forward motion we get, as total consumption of calories per kilometric tonne offered with the most up to date engines :

— 240 for the Berliet Diesel lorry;
— 120 for the ordinary slow goods train;
— 48 for the Diesel locomotive train;
— 20 for the electric train.

If the labour output is considered, very similar results are obtained. A study made by a high official in 1947 (2) estimated the traffic of the public road hauliers as 21.6 thousand million units of traffic (tonnes/kilometres and passenger/kilometres), and the number of men needed to cope with this traffic as 280 000 (without counting the men of the Bridges and Highways Department, garage personnel, fuel distributers, road police, nor the men employed in the construction of the vehicles), while in the same year the railway transported 31.3 thousand million passenger/kilometres and 45.3 thousand million tonne/kilometres with 480 000 men. These figures show an output of 150 000 units of traffic per man in the case of the railway and 76 000 units in the case of the road.

Similar results would be obtained by an examination of the material consumed by the two methods of transport. A study made in 1945 by another high official showed that for distances of 5 to 600 km (3.10 to 373 miles) the materials consumed by the road, compared with the railway was in the ratio of 5.4 for steel, 6.7 for non ferrous metals, 1.85 for wood and 2.35 for lubricants... (1).

Future prospects.

Thus in the case of the traction proper, the railway to date has retained an indisputable superiority. As regards the future, it seems to me rather futile to speculate concerning the reductions in cost which might benefit railway traction (by progress made in Diesel or electric traction, or by the use of new types of engines, such as turbo-jet engines, or even motors driven by nuclear energy...) compared with the similar reductions that might benefit road traction... I think it more to the point and more encouraging for the railway to note that the task of the railway technical experts of the Traction, Permanent Way and Operating Departments will always be facilitated by the innate superiority of railway traction : we should therefore have the fullest confidence that they will continue to make use in the future, under the optimum output conditions, of the most up to date techniques for the transformation of power.

(1) Cf. lecture given by M. Dugas, Manager of the S. N. C. F. to the « Centre d'Etudes Supérieures des Transports », on the 10th March 1943.

(2) M. Rouelle, Reporter to the Conseil Supérieur des Transports.

(1) Study by M. Bizot, 1st November 1945, « Cercle des Transports ».

Undoubtedly, the progress of the railway will involve many new investments, and in France many will be disturbed by the size of the credits the S. N. C. F. will ask for in this connection. But I am afraid that in all honesty our compatriots do not always get a true idea of certain proportions. The receipts of the S. N. C. F. were 89 thousand millions in 1946, 133 in 1947, 241 in 1948, and 267 in 1949. Now the capital credit available, apart from reconstruction funds, was only 4.155 thousand millions in 1946, 11.975 in 1947, 20.42 in 1948 and 26 in 1949, i.e. a total of 62.55 thousand millions in 4 years, the average turnover of the S. N. C. F. having been 182.5 thousand millions in the same period. When an industry only invests a sum representing 30 % of its annual turnover spread over 4 years in renewing its equipment, is this to be considered an excessive amount or should we not rather regret that an age old technique does not spend more freely under this heading [1]. When a motor firm renews its equipment in order to change the type of vehicle it is manufacturing, does it not make a relatively greater financial effort?

Why then, you will ask, are so many Frenchmen uneasy about the future of the railways, why these definite affirmations from certain representatives of the automobile industry concerning the outdated character of railway technique? I think it can be explained to some extent by the ignorance of so many concerning the value and real possibilities of railway technique. It can also be explained by the absolutely abnormal state of competition which causes the railway to lose a great part of its traffic. But it can also be explained by the new possibilities which the automobile offers as regards the supplementary characteristics of transport : in this field the automobile has brought about a real revolution, and has tought the railway an important lesson.

(1) In other branches of French nationalised undertakings, the amount of capital invested has been considerably larger. Bringing down all the figures to a common monetary unit (the 1949 franc) the total capital investments made during the three years 1947, 1948 and 1949 was in the case of the S. N. C. F. : 76 thousand millions for an average *annual* turnover of 280 thousand million; for the « E. D. F. » : 254 thousand millions for 260 thousand millions; for the coal mines : 181 thousand millions for 450 thousand millions.

In England, the capital invested in the railways in million pounds sterling was 133 in 1947, 161 in 1948 and 170 in 1949.

The supplementary characteristics of transport.

The handicap of road traction compared with railway traction is due to the use of the road itself and the small capacity of the unit. Now, it is precisely these two elements that road transport has used considerably to perfect the elementary operation of traction, by generalising the « door to door » technique and « individualising » transport.

The door to door technique.

Undoubtedly, since its inception the railway has realised *door to door* services *commercially* by linking up its stations to the places or homes of its clients by means of connecting passenger or goods services. The « Ouest » Railway in 1858 for example transported 5 million passengers by means of 167 coaches connecting with the trains and delivered home 22 000 t of express goods traffic and 400 000 t of slow goods traffic by means of 115 agency haulage services. Today the 3 043 official agencies, haulage and reconsigning services of the S. N. C. F. serve 14 170 places representing 23 million people, or 80 % of the total urban population of France.

By means of private sidings, the railway has long realised door to door services without transhipment, which is what I mean essentially by the door to door *technique*, for a proportion of its traffic, a proportion much larger than is often credited (I will return to this point later).

But the automobile technique has been able to do the same for nearly all its traffic, thanks to the fact that each vehicle is

a self contained unit from the point of view of the load, and thanks to the extensive network of the road system.

Undoubtedly, in the case of public passenger transport, it often remains necessary to tranship from car to train when the distance exceeds the regional boundaries. But even in the case of long distance journeys, there is an increasing vogue for tourist travel in motor vehicles, from the starting point until the return to the starting point, the motor vehicle remaining with the passengers all the time and taking them from hotel to hotel.

In the case of goods, public transport of parcels often involves, as on the railway, transhipment at the two end centres, with terminal services to collect and distribute the parcels. But as soon as the lots reach a certain importance, and *a fortiori* for full loads, the door to door technique is the rule.

As for private passenger and goods transports, they have progressed in just the same way, and represented in 1948 the use of 1 600 000 vehicles (tourist vehicles and private lorries) out of a total of 1 700 000 vehicles...

To lay our finger on the enormous advantage as regards costs made possible by the door to door technique, it is sufficient to examine the other side of the question; i.e. : the cost to the railway of the terminal charges which it has to support in respect of a great part of its traffic. For example the complete cost of a load of 20 t of goods (1) is 3.85 fr. per kilometre for a journey of 200 km (124 miles), not including terminal haulage, whereas it is 5.85 with terminal haulage at one end and at both ends 7.85 fr.; this is the same as if the railway had carried the goods 400 km (248 miles) instead of 200. On the other hand, if the journey is 800 km (496 miles) instead of 200, the cost without haulage, which amounts to 3.40 fr. only shows a small increase to 3.90 fr. with haulage at one end and 4.40 fr. with haulage at both ends; the cost is no longer doubled by the haulage at both ends, it is merely increased by 30 %. For the average distance (258 km = 159 miles in 1948), haulage at the two ends increases the cost of railway transport by 3.75 to 7 fr., i.e. 87 %. The railway which has done wonders technically to decrease the cost of traction from 3.75 fr. to 3 fr. for example, has consequently, *outside the rail journey*, an immense field, that separating 3.75 fr. from 7 fr., in which to investigate reducing the cost price. We will see later on what possibilities there are in this connection.

In other words, it can be said that the average railway costs, which are very much lower than those of road transport no matter what the distance, provided no terminal haulage services have to be included (1), rise very rapidly for short journeys with terminal transport at both ends, and catch up with the road costs at a limiting distance which varies with the size of the load (2).

Door to door technique however is not merely advantageous from the point of view of the cost of transport. It also confers on the users *other advantages*, very important ones, which the user may at times take into account and which may make preferable a form of transport which is apparently much dearer. I will briefly recall them.

First of all, the door to door technique greatly shortens the time taken for the journey, by avoiding the time spent on transhipments and cartage. In addition, it considerably diminishes the amount of damage in the case of certain goods which will not stand up to much handling. I stated that the railway on the average has very little to pay in the way of damage. This is true as far as rail transport is con-

(1) On basis of 1949.

(1) The ratio of the two costs is then 1 to 3 for a load of 20 t.

(2) This distance is about 100 km (62 miles) for a load of 20 t.

cerned, and it is true for most kinds of goods; but it is precisely the terminal transhipment of fragile goods which may cost dear — and I am not only speaking about goods the fragility of which is known to everyone (eggs for example) but also bulky goods like coal and flints, the transhipment of which can appreciably spoil the quality.

Door to door technique also makes it possible in certain cases to make large savings in the matter of packing, which sometimes even exceeds the cost of the transport.

Finally, the absence of handling of the goods often is a great attraction psychologically to the user.

The individualisation of transport.

The « individual » character of road transport is as important a trump card as its door to door possibilities. It has made it possible to develop considerably the formula of private transport which adapts itself the most easily — one might say « all by itself » — to the needs of industrial and commercial firms.

But it has also enabled considerable improvements to be made to the organisation of public transport, by facilitating the accessory operations, such as immediate payment for the goods, recovery of empties, publicity for the consignor, etc.

And this individual character has also greatly encouraged the *specialisation* of the vehicles, with adaption of the coachwork and sometimes even of the chassis and mechanical parts to the special needs of commerce or industry. Without doubt this is a tendency which often leads to giving up freight for the return run, and therefore leads to a reduction in the output of the vehicles; but this loss can often be made good by the great economies obtained, and in the whole, further progress will have been made. This is the case for example with tank wagons, and cisterns, fodder lorries, cattle trucks, and vans adapted for such and such kinds of goods, etc.

The terminal handicap of the railway.

Is the railway, which as I have shown has a very large margin of superiority as far as the actual transport is concerned, to be outclassed by its road competitors because it only goes as far as the stations, and transhipments in the end stations have drawbacks which it is becoming more and more difficult to tolerate, drawbacks which I have summed up by the expression « terminal handicaps » ?

Even supposing that the short distance traffic, for which this handicap becomes too heavy from the point of view of the cost, to be lost, is the railway to lose all the traffic for all the distances for which the same handicap increases to too great an extent the final cost to the user, by extending the transit times (the time taken for the terminal operations often exceeds that required for the journey), and by the restrictions of the railway when it can offer neither door to door services nor the possibilities of individualising the transport ?

In examining this important problem, I will leave on one side the question of passenger transport. Public transport cannot, indeed, defend itself against the development of the tourist vehicle. As for the motor coach, under the same hypothesis of normal competition, it is essentially the competitor of the railway over short distances, but especially in those cases when the latter cannot give satisfactory services; its use for long distances is normally only conceivable for requirements quite other than those of the ordinary railway services (itineraries of a tourist character).

I will therefore limit myself to the transport of goods, the essential basis moreover of the past — and I hope the future — prosperity of the railway. In the case of such transport I intend to show you that apart from short runs and certain exceptional cases of long distance traffic for which the lorry has no rival (for example very urgent transports), the railway already can, and will certainly be able to-morrow also, provide solutions both for door to

door transport and individual transport. With such solutions it can even combine *the advantages normally offered by the two techniques,* and in addition decrease to its profit in certain cases the distance below which it becomes dearer than road transport.

It is no longer question of railway experts deriving the maximum profit from a natural advantage, but on the contrary they must constantly use their ingenuity : and, undoubtedly, the results already obtained, if not final, show that completely satisfactory solutions to the problems are possible.

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Private sidings.

I have already mentioned the oldest method of procuring door to door transport used by the railway : the *private siding.* Whenever this is possible materially and is justified by the amount of traffic, it is the best method giving together with the special advantages of the door to door technique, transit times comparable with those for the transport from station to station and often a considerable saving in the terminal costs.

It has already been largely developed (and will continue to develop in the future). At the present time about 40 % of the total traffic of the S. N. C. F. travel from one private siding to another. Traffic to or from a private siding at one end only represents 40 % and traffic which does not make use of private sidings at all is only 20 % [1].

The wagon-carrying trailer.

In some cases although the private siding would be the best solution economically because the traffic of the user is considerable, it is not possible to provide one, on account of town planning restrictions, the level of the site, or distance from the station. Again, it may happen that the number of wagons arriving at a given place for each firm does not justify the construction of a private siding, though grouping the several firms together on a common siding would provide a sufficient traffic, only unfortunately their premises are too far apart. An excellent solution for providing door to door services in such cases is the *wagon carrying trailer.*

As far back as 1815 a Bavarian Engineer, BADER, had the idea of transporting wagons on vehicles with « road bogies ». But this proposal, and the others that succeeded it, did not manage to solve the practical difficulties due to the turns and hills encountered on the road, and it was not until 1914 that a heavy wagon was first carried by road : this was a travelling wagon sent to an exhibition at Stuttgart.

Then a French Engineer, BARTHELEMY, in 1931 invented a wagon carrying semi-trailer, which was tried out at Marseille, but these trials were not followed up; about the same time, a German CULEMEYER designed an improved type of vehicle, which was largely used by the German Army during the last war to refuel its airfields with tank-wagons conveying petrol.

(This vehicle is described in Mr. GIRETTE's report on Question VIII of the Rome Congress 1950.)

When one or several clients can provide sufficient traffic for a suitable user of the wagon carrying trailer, in addition to the advantages of door to door transport, this leads to a reduction in the cost of haulage, which may be as much as 40 % in favourable cases. A well used trailer can make 18 single runs a day if the client lives within a kilometre of the station, 10 runs if the distance is 5 km (3 miles) and 6 if it is 10 km (6 miles). They can transport 20 to 40 thousand tons a year. Consequently in spite of its high cost (4 to 5 millions at the present time) the « bulk » haulage which it makes possible costs appreciably less than when goods have to

(1) As precise statistics were lacking, these figures were obtained by taking several soundings.

be transhipped and hauled in ordinary lorries which can only take small loads.

These figures also show that a few hundreds of such trailers could deal with a large proportion of the full load traffic which suffers from road competition. The total full load traffic on the S. N. C. F. amounted to 153 million t in 1948, of which 105 million were bulky goods which do not suffer much from competition at the present time [1].

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The rail-road trailer.

When the traffic is not sufficiently large to justify the use of the wagon-carrying trailer, because it is made up of « lots » rather than full loads, the *rail-road trailer* is the best method of obtaining door to door services, at least in the case of transport carried out on important services.

It should be pointed out that the idea of making an « amphibious » vehicle, which can travel on both railway and road — a very ancient idea since TREVITHICK at the beginning of the 19th Century invented amphibian omnibuses — has never culminated in a practical solution, in spite of a recent attempt by WILLÈME. The only successful methods have been those superimposing the two vehicles : either the wagon on the road trailer, which results in the wagon-carrying trailer we have just dealt with — or the so-called « rail-road trailer », which we are now going to consider.

(The type of rail-road trailer now used in France is the U. F. R. trailer which is described in Mr. GIRETTE's Report.)

. . . .

This trailer is used on a fairly large scale (more than 600 are in service at the present time) by road hauliers who came over to railway traction when their transport licences were annulled by the coordination decree of the 12th November 1938; the S. N. C. F. have offered them in exchange a certain amount of financial assistance. These hauliers have set up a technical group organising the regulation of the carrying wagons, the trailers and the tackles, obtaining thereby a turn round at least equal to that of the best used road lorries (for example : 9.7 single journeys by month on the Strasbourg-Rennes run, 14 on the Strasbourg-Paris and 17.3 on the Bressuire-Paris).

Containers.

Finally, when the units of traffic are not large enough to justify the processes considered above, the container is a solution which not only gives the advantages of door to door services but also technical and commercial benefits due to the splitting up of the capacity of the wagons.

The container is so well known that I do not think it is necessary to go into details here.

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At the present time the S. N. C. F. is bringing its efforts to bear upon the two essential problems with large containers : handling in the stations and at clients premises, and the « movement » of the containers on the railway.

Handling in the station and at clients premises. — The organisation of the *handing at the station* should no longer be a joint liability as regards loading or unloading the wagon from or onto the lorry, in order to avoid reciprocal delays — on the other hand unloading onto the ground must be avoided (a method currently used) in order to halve the work of the handling gear : this is of value not only from the point of view of the cost, but also as regards the output of the container service, which also has a strictly limited area in which to work. Taking these details into account, the S. N. C. F. has found the best solution to be a mobile handling

[1] Coal, minerals, metallurgical products, building materials, fertilisers, timber, and vegetable fuels.

machine (5 t mobile crane, or better still a haulage tractor fitted with a 5 t crane), the haulage services being assured by means of tractors and semi-trailers. The latter are left at the station by the tractor, either empty or loaded with containers ready to forward, and are loaded or unloaded at the most convenient moment by the station services.

At the client's premises, the large containers which generally carry goods which take a long time to load or unload, can be left on the trailers, or if you like removed from the trailer and unloaded by the tractor if this is fitted with a crane. In some cases (where clients have no unloading quay or there is a gateway to go through), a low loader semi-trailer may be of value.

The ideal equipment for handling and hauling large containers : tractors equipped with a crane and semi-trailers, some of which are low-loaders, will take some time to realise, and at the present time several prototypes are under construction.

The movement of large containers. — The other problem is the organisation of the movement of the *large containers* to accelerate their turn round and facilitate grouping them together on the same wagons, so as to reduce on the one hand the amortisation costs of the containers, and on the other hand the cost of the railway transport.

With this object in view the S. N. C. F. has set up, through the intermediary of the S. C. E. T. A. and the participation of many agencies, an affiliated company known as the « La Compagnie Nouvelle de Cadres » which has a double role to play. First of all, it has to group the containers handed over by the agencies (which the new Company is not replacing) or by certain other consigners together on the wagons, in order to get the best possible rates from the railway. It also has to regulate the use made of the stock of containers for which it is responsible, in such a way that the best possible turn round is obtained and empty runs avoided. For this latter work it is obviously better to have a Company operating as a free enterprise which can balance the freight offered with the same freedom as a road transport undertaking, rather than a railway undertaking subjected to all the regulations, especially as regards supplying containers in the order asked for. The results of the first years working of this Company are extremely encouraging, since the number of cantainers for which it is responsible has already increased five-fold.

Additional advantages of railway door to door services. The individualisation of transport.

Not only do private sidings, wagon-carrying trailers, rail-road trailers and containers give door to door services just like the lorry, but they also offer the advantages of individualising the transport the value of which has been so brought out by road transport.

In reality the railway, much more than is believed, has always gone in for specialisation of the stock for a certain number of goods, and this specialisation will obviously help both the use of private sidings, and wagon-conveyors.

Quite apart from the large groups of wagons (covered, flat-wagons and open wagons) each of which moreover is subdivided into several categories (for example : open wagons with high or low sides, fixed or drop) the S. N. C. F. uses more than 12 000 special wagons owned by it to which must be added nearly 40 000 privately owned special wagons.

The special wagons are divided up into more than 20 groups : various kinds of tank wagons, covered horseboxes and cattle trucks, covered double floors wagon for conveying livestock, covered with stages for milk churns, insulated covered, refrigerator covered, open wagons with pivoting bolsters, « coupled » flat wagons, superspecial flat wagons, coke wagons, hoppers, etc. And some groups, like the superspecial flat

wagons are subdivided into 25 groups (flat wagons with supports for plates, low-loading flat wagons, etc.).

This already represents a great-endeavour to adapt the coachwork to the varied requirements of the users. The efforts of the railway in this direction are only limited because of the need to avoid complicating the distribution of the stock to an undue extent and so as not to slow down the turn round too much.

With mixed rail-road vehicles and above all with containers operated according to the rules of private enterprise, the adaptation to the different kinds of traffic can be pushed as far as it is reasonable to go, and their possibilities from this point of view are even greater than those of the lorry, whose coachwork is in one with the chassis and engine.

The other advantages of road transport tending towards the individualisation of the transport, such as the collection of empties, the collection of accounts, etc., can be offered by the different railway door to door services. There is only one exception as far as I can see, which concerns the representation of the firm owing the goods, but this exception is rather the apanage of private transport. Moreover, it is not certain that the employees representing the different producers who accompany the lorries and are responsible for delivering the goods to the wholesale or retail firms, are not too costly an organisation of distribution, and whether, in this respect, France should not follow the example of other countries. Some experts are of the opinion that in order to reduce the distribution costs as reflected in the cost price of goods, several producers should agree upon the selection of a common representative in a given place, who would be responsible for stocking sufficient quantites of the different goods and executing the orders of the different retailers. With such an organisation, the railway would once more have the advantage as regards the main transport, while the automobile would win as regards the distribution.

And in addition the qualities proper to the railway. — But in addition to the advantages of the door to door technique and the individualisation of the transport, the methods which we have reviewed carry with them all the other advantages of the railway technique, such as the considerable economy of transport, safety, and also the placing at the users disposal the opportunity for loading over a much longer period than the time a lorry is standing available; this last facility is very important in some cases, as it makes possible a more rational organisation of the work in the sending or receiving premises.

Reduction of the terminal charges. — Finally two of these methods, the private siding and the wagon-conveyor, already make possible *an appreciable reduction in the terminal charges*, thereby bridging the gap, to the railway's advantage, between the road and railway costs from one end of the journey to the other; this is indeed a certain amount of progress.

In the case of rail-road trailers and containers, it is a question of deciding if the same applies and if the obvious savings from the point of view of damage, handling at either end, and even, in the case of small containers, in the handling at intermediate stations, make up for the reduction in the useful load carried per wagon. I do not know if this second stage of progress has already been realised, but I am sure that it will be in the future, when the extension of these methods makes it possible to organise terminal services with a high output, as is already the case with the U. F. R. Champ Dauphin station at Paris, and when the progressive increase in labour costs will make the reduction in handling of ever greater account.

The effects upon the receipts.

Under these conditions it is not astonishing that the development of these different methods should lead in nearly every case to traffic being recovered. Undoubtedly

these methods are sometimes used for traffic the railway has never lost (how could it be prevented?) which is moreover consolidated thereby. But they are applied most often to traffic which they have enabled the railway to recover. Is it necessary to recall that the rail-road trailers have been acquired by road hauliers who thereby restore almost automatically to the railway their old clients? Is it necessary to stress the fact that the private siding is the best guarantee of fidelity that can be imagined between its owner and the railway? Is it necessary to enumerate all the traffic that the railway has recovered by the use of containers?

As for wagon-conveyors, experience of which is of more recent date, I might state that in 1949, whereas the general traffic as regards wagons remained at more or less the same level as in 1948 on the S. N. C. F. (+ 2.3 % in useful tonnes), the traffic of new users of the wagon-conveyors increased by from 14 % to 145 % (in useful tonnes) compared with 1948.

The « co-ordination » aspect.

From the point of view of the co-ordination of transport, are not the railway solutions of the door to door technique the best answer to the problem arising from long distance lorries duplicating the railway over important services? The user receives exactly the same quality of service as with the lorry, the haulier retains his clients and the management of his business whilst using the railway for the actual transport, and finally the community profits by the considerable reduction in costs which railway transport over long distances gives compared with road transport.

The question of small lines.

To round off the problem of terminal full load traffic, I must say a few words about a particularly topical question: that of the possible closing down of secondary lines with little traffic. Certain small lines of the S. N. C. F. do not appear to have sufficient traffic to meet their costs: should services organised by the railway take their place, or should they be closed down purely and simply, leaving it to private enterprise to link up the users with the main railway system?

To get an exact idea of this question, certain preliminary explanations are necessary.

Deficits and the tariff structure.

First of all the idea of a « deficit » on a secondary line, i.e. the idea of a difference between the receipts and expenses of such a line, is of no practical significance. Let us limit our examination if you like to the lines of the S. N. C. F. which only operate goods services (about 10 000 km = 6 200 miles) as it is only in such a case that the question can arise, the total closing down of lines operating passenger services being hardly imaginable in the present state of the techniques. Having said this, we must remind ourselves that the goods traffic on the secondary lines is essentially a traffic *in transit* making use of the secondary line and then the main line, one after the other. What traffic receipts are to be attributed to the secondary line? Are the receipts to be calculated for each transport according to the mileage over the secondary and over the main lines? But railway rates, adjusted to the average cost, are now calculated on the total number of miles without taking into account the expensive and the cheap mileage. It is just as though average forfeit mileage rates were taking the place of the multiple rates based on the costs of the lines used. The present method of dividing up the receipts consequently gives the small lines an artificial deficit and greatly profits the main railway.

Under these conditions would it not be better to rectify the rating system without delay, by weighing the rates by coefficients proportional to the actual costs of the lines used? On the contrary, I believe that when it is a question of deciding whether

a secondary line shall be retained or closed down, the kilometric rates without any such increase give in most cases a better economic orientation that a strictly adjusted rate. On most of the secondary lines of the S. N. C. F. the kilometric rates suffice in effect to favour transport beginning or ending on such lines : this is due to the fact that such transport only has to pay the direct costs involved on the main railway where they are additional to the traffic belonging to that railway, and these are of the order of 50 % of the total costs (1). Calculations show that on most of these lines, the rates should be adjusted in the opposite sense in order to give the best economic results (little or no profit) and that on the very bad lines the adjustment should be much less than proportional to the costs (2).

To sum up, the apparent deficit which the kilometric division of the receipts impose upon the secondary lines very often masks a definite profit for the railway as a whole (this remark would also apply in the case of passenger feeder services).

Finally, the rational criterion for closing down such lines is not an arbitrary deficit, but the lower cost to the community of the road services compared with the railway services. This criterion moreover was admitted by the new decree.

Organisation of the substitute services.

When according to this criterion the road services seem to be the better, the considerations given above make it necessary to maintain a tariff for the journey from one end to the other more or less carefully assessed and the organisation of a substitute services, as failing these conditions, the user will nearly always have to stand a large increase in his transport costs, in order to link up with the main railway, which is all the more absurd as it is the result of making economies.

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(1) This scale is based on the S. N. C. F. cost price accounts. Price per useful tonne offered on the Paris-Marseille run : 1 430 fr. (total charge) and 712 fr. (direct costs). On the Paris-Lille line these figures become 497 and 282 fr., and on the Paris-Bordeaux 696 and 223 fr. (July 1948).

(2) Here is a simplified method of calculation which supposes that the direct costs represent 50 % of the total costs.

Taking :

- l as the length of the secondary line;
- L as the average journey on the main network for traffic beginning or ending on the secondary line;
- r and p the average kilometric receipt and average complete kilometric costs of the main railway;
- Kp the average complete kilometric costs of the secondary railway,

it can be admitted that traffic beginning or ending on the secondary line on the average travels $\frac{l}{2}$ over this line; the receipts per unit of traffic is then on the average according to the present rates :

$\left(\frac{l}{2} + L\right) r$ or making a first approximation

$$= \left(\frac{l}{2} + L\right) p.$$

The costs for the same traffic are on the average :

$$Kp\,\frac{l}{2} + \frac{p}{2}\,L.$$

and the profit or loss :

$$\frac{p}{2}\,[L - (K - 1)\,l]$$

There is a profit if $K - 1 < \frac{L}{l}$, which can be verified on most secondary lines.

On the very bad lines where this condition is unrealisable, the best adjustment of K′ would be that giving no profit.

The condition of no profit can be written :

$$K'\,\frac{l}{2} + L - \left(K\,\frac{l}{2} + \frac{L}{2}\right) = 0$$

$$\text{or } (K' - K)\,\frac{l}{2} + \frac{L}{2} = 0$$

which gives $K' = K - \frac{L}{l}$, which is much lower than K (the average distance of transport on the S. N. C. F. was 258 km [160 miles] in 1948).

With a few rare exceptions [1], it is impossible therefore to separate the small lines to be operated by road services from the main railway. As the new co-ordination decree stipulates, the railway should remain responsible to the consignor for the transport from one end to the other. Such a separation moreover would be a capital error for the railway when there is active long distance competition (as we have already remarked with regard to the centre stations), as the substitute transport, especially when the user will have to pay more in order to link up with the main railway, will tend progressively towards transport from one end to the other, and even, once it has sufficiently developed, towards the main services. No road haulier would agree to giving up his responsibility for the terminal transport; do not think the railway is less able to defend the interests of its traffic...

Expected results. — What is to be expected from such enquiries, enquiries which the S. N. C. F. has carried out very willingly in its own interests? Certainly, no miracles. It would indeed be a miracle if their conclusion was that, as many desire, we should return to the system existing before the FREYCINET plan [2]. They do not see why, with the respective evolution of the road and railway techniques during the last 70 years, the substitution of the one for the other should be an economically paying proposition in the exact degree in which Mr. DE FREYCINET put forward his programme of secondary lines in 1878-79.

In any case the enquiries in question should be made with care, and it must be assumed that before there was any question of substitution, the railway operation of the secondary lines has made its various regulations as flexible as possible (signalling, work, level crossings, etc.) and has profited to the full from going over to Diesel traction, which is only delayed at the present time by the shortage of capital. This programme of making the small lines more flexible and up to date, which may have a profound effect upon their solvency, should moreover be extended to a large number of secondary lines, whether under threat of being closed down or not, and this is the subject of a recent proposal by the S. N. C. F. Having made this clear, there is no doubt but that a certain number of such lines should be closed down, but much fewer than is generally estimated.

Finally, it must not be thought that closing down lines in this way will lead to considerable savings. It should be recognised in this connection, that if the traffic of some of the secondary lines is small, so are the corresponding costs. The S. N. C. F. only employs 11 % of its total staff on all the secondary lines which represent half the mileage of the whole system: consequently it is not the technical transformation of a part, doubtless a much smaller part, of the national system which will lead to great economies for the S. N. C. F.

On the other hand, the substitute road services to be introduced will doubtless make it possible to multiply the door to door services under the most advantageous conditions, since such services, all of them full load, can be worked practically *without additional expense* by the substitute lorries. They could even go hand in hand

(1) In the case of very bad lines where the railway rate, partially adjusted as indicated above, exceeds the cost of road transport.

(2) M. DE FREYCINET, Minister of Public Works, prepared a programme classifying the lines of the system of general interest, not only the new lines yet to be built, but also those already completed or being completed and already conceded to small Companies of general or local interest. This programme, which covered 18 911 km (11 751 miles) of lines (more than 10 000 [6 200 miles] of which has still to be completed or built) was set out in the law of the 17th July 1879. By the Conventions of 1883, 11 000 km (6 835 miles) of these lines, 3 600 km (2 237 miles) of which were already in operation, were conceded to the main line Companies, whose lines were thereby increased from 23 000 to 34 000 km (14 292 to 21 127 miles).

with a development of the methods of providing door to door services, which would facilitate the concentration in certain stations of rail-road transhipment services. They should therefore make it possible to lower appreciably the cost price and modernise the terminal services in the case of the railway full load traffic.

CONCLUSION.

In this way the railway transformed, renovated, and restored to youth by its incessant efforts, will always have the trump cards in the competitive game.

Contrary to what might be expected, the motor revolution has not enabled road transport after all to catch up, even partially, with the traffic it lost to the railway at the time of the stage coaches and mails, which the railway has been able to retain ever since thanks to the constant progress made in locomotion, the permanent way and the operating.

On the other hand, the extraordinary progress achieved by the automobile has been that it makes it possible in most cases to have direct liaison, by means of transport which is most often « individual » between the consignor and consignee. If the « terminal handicap » of the railway does not exist in the case of the parcels traffic (where the organisation is such that the railway has a powerful advantage which it has already profited by and will profit by still more in the future) — if it becomes very inconvenient in the case of passenger traffic (I am thinking above all of the future development of the tourist coach against which the railway can only complete by constantly improving the comfort and rapidity of the actual railway services) — its consequences in the case of the *full load* traffic, which is and must continue to be the basis of the prosperity of the railway, runs a risk of becoming still greater if the railway does not renovate its methods.

When two terminal hauls are necessary, the cost of the actual transport is nearly *doubled*, for an average mileage (1). This is the reason why the very great advantage as regards costs which the railway has over the road when there are no terminal charges to be borne, under the inverse hypothesis, finds itself reduced more and more as the distance decreases, until it disappears completely below a limiting distance which varies with the size of the load (2).

First consequence : the railway under these conditions can no longer defend traffic over distances, from one end to the other, which are lower than this limiting distance, except in the case of bulk transports, and when it can make use of private sidings, which reduce the terminal charges to practically nil and give all the advantages of the door to door technique.

On the other hand, if the railway is naturally going to take steps in the future to see that its traction costs diminish as quickly as those of its competitors, it must also take care to see that its terminal costs also fall as quickly as those of road transport for average or long distances, without which the limiting distance to which I have just alluded will rise to a dangerously high level. This result should be arrived at very easily, under one condition : the conditions under which these terminal services are organised should be very strictly controlled (which does not mean to say that the railway should operate them itself), as the costs of such services are *just as important* to it as the actual railway costs, when making economies. The adversaries of the railway (and unfortunately it has its adversaries) know just what they mean when they want the railway to be forbidden to deal with any matters outside the permanent way, so that it would be completely dependent upon the initiative of private enterprise whose interest does not always coincide with its own. As though the long distance road haulier

(1) 258 km (160 miles) in 1948.

(2) A distance of at least 100 km (62 miles), as already stated.

would agree to be divorced from the haulage of his traffic...

The second consequence of the « terminal handicap » and doubtless the most important, is not the cost of the transport to the user. It is the lower quality from his point of view of transport from one station to another with terminal transhipments, compared with the individualised door to door transport made general by the automobile. But these advantages of the automobile, the railway can also offer either by means of the old methods (private sidings) or the new (rail-road trailers, wagon-conveyors, containers), especially when it manages to extend, as it will not fail to do, the fast regime of transport to all the door to door traffic. And with all these methods it will continue to offer the advantages proper to railway technique, and in addition it may be able to change to its own profit the notorious limiting distance where the costs of the two techniques offset each other, the methods in question constituting already, or in the near future, progress of the « second degree » i.e. progress in the costs of the transport from one end of the journey to the other, as well as in the quality of the service (cost to the user).

We should therefore have confidence in the railway. Undoubtedly the automobile will remain very progressive and everyone will congratulate it. But its trump card, the door to door technique, was a birthday gift which the railway did not appreciate until the parallel progress of the two methods of traction led the automobile to compete over distances till then reserved to the railway. Progress in the future for the railway will be progress in the traction (and we have seen the facility with which the railway, thanks to the permanent advantages confered on it by the nature and layout of its lines, has always retained its lead in this field), or progress inspired precisely by the railway technique: utilisation of the tractor-trailer or the container technique to make the loading capacity independent of the motor unit — commercial concentration in certain sectors to obtain a power comparable to that of the railway, without losing (if possible) its mechanical character...

This optimistic conclusion, which refers to goods transport, supposes however that the following conditions shall be realised: the railway statutes will not be further burdened *a priori* compared with those of the road, and that the railway will be allowed to organise without hindrance, like its competitors can do, the whole of its transport, including the terminal hauls, for the traffic handed over to it under its rating conditions. The realisation of these conditions is in the hands of the public authorities, and we are sure that they will recognise their necessity and their legitimacy. And so the railway will live...

[621 .335 (493)]

Bo-Bo express electric locomotives for mixed traffic on the Belgian National Railways.

In order to enable the lines now being electrified, « Linkebeek-Antwerp North », the junction « Brussels North-Brussels South » and « Brussels South-Charleroi », to be worked, it will be necessary to create a pool of electric locomotives.

From a first batch of 26 units, the Belgian National Railways have placed an order for three special Bo-Bo type electric locomotives for mixed traffic with the Brown Boveri Co. (BBC) and the Forges, Usines & Fonderies (FUF) of Haine-St-Pierre.

The Brown Boveri Company are to be responsible for the provision of the electrical equipment, the mechanical parts being supplied by the Forges, Usines and Fonderies, Haine-Saint-Pierre. When the locomotive shell is completed it is sent by rail from Haine-Saint-Pierre in order to have the electrical equipment fitted by the Brown Boveri Company in their assembly shops at Munchenstein near Basle. It can, therefore, be said that they are a Belgian-Swiss product, due to the close collaboration of the two above mentioned firms. This procedure is by no means new, as, before the war, these firms built jointly locomotives for the Northern Railways of Spain.

These engines are now nearing completion; one, in fact, is already in service. This article is intended to show, broadly, the principles of construction and design.

Traffic programme.

The BBC-FUF locomotives attain a maximum speed greater than that laid down for the normal type of the Belgian National Railways. The specification does not call for a higher speed than 105 km (65 miles) per hour although the makers have guaranteed a speed of 125 km (78 miles) per hour. The locomotives are designed specially to meet conditions of service peculiar to the Belgian Railways, in order to create a prototype which may be put to extensive use in future schemes and which will be sufficiently adaptable to be used in all goods and passenger services of the most varying descriptions. The principal characteristics are as follows :

1. Hauling of heavy goods trains (max. 1 600 metric tons — 1 575 English tons) at a fairly high « goods » speed of approx. 55 km per hour (34 m.p.h.).

2. Hauling of lighter passenger trains (approx. 400 metric tons — 394 English tons) at a fairly high speed which might reach 100-125 km per hour (62 to 78 m.p.h.).

3. Very rapid acceleration in view of the layout of the system, short distances between stations, frequent stops of numerous semi-fast passenger trains. Therefore, a relatively high general speed is maintained.

General description.

The BBC-FUF locomotives will have a total adhesive weight of the Bo-Bo type, having two bogies and four motors, i. e. : one per axle. This system has given particularly good results on the Ae 4/4 locomotives of the Bern-Lötschberg- Simplon (BLS) Railway on their arduous mountain line. The excellent service given by these engines has led the Belgian National Railways to incorporate similar principles, at least for the mechanical portion, as the BLS system is fed by 15 000 volt single phase 16.2/3 cycles, whereas the Belgian National Railways' system is 3 000 volts D. C.

The use of the whole of the weight for adhesion, i. e. the absence of deadweight, is particularly interesting in view of the modern tendency with regard to the « reduction of weight ».

The total weight of a locomotive will be approximately 82.7 metric tons (81.3 English tons) of which the mechanical portion will be approximately 43.2 metric tons (42.5 English tons) and the electrical portion 39.5 metric tons (38.9 English tons).

The four motors are fixed rigidly to the bogie frames and are then spring suspended in relation to the axles. The unsuspended weight of the locomotive, i. e. : wheels, axles, large toothed crown wheels and gears, etc., is reduced to the absolute minimum.

The four motors are permanently coupled in series, in groups of two. The drive is by a flexible disc transmission of the Brown Boveri type, similar to that fitted on the locomotives of the BLS Railway in Switzerland (*).

Transition between the coupled-series and the coupled-series-parallel, is carried out by the bridge method, which prevents a momentary fall in the tractive effort.

Each group of two motors is cooled by a motor ventilator group. The starting resistances are cooled by a third motor ventilator group.

The compressed air equipment for actuating the brake and the various pneumatic controls has two groups of compressors.

The lighting and electric control circuits are fed by a 72 volt direct current converter group, working in parallel with an accumulator.

The motors of the above mentioned auxiliary groups are fed directly by 3 000 volt direct current.

The locomotives have two driving cabs, each fitted with complete control equipment. The locomotives are arranged for driving in pairs and by coupling the two units together an output of 2 × 2 800 HP per hour is obtained.

Motor suspension and transmission of the coupled motor to the wheels.

In order to avoid movement due to irregularities of the track, a large number of systems for driving the axles have been proposed, since the transmission by rods has been abandoned; for example,

(*) This type was described by Mr. Adolphe Hug in his article « Individual axle drive » published in the *Bulletin of the International Railway Congress Association* for November 1948, p. 679.

one of the oldest, the « Gearless » system, in which the induction motor is fixed directly on the axle. The motor therefore moves with the axle and is, consequently, submitted to the maximum vibration.

Nose suspension (tramway type) is still the most universally used in Europe. It is employed on a large scale for all vehicles of average power and relatively low speed. It is adopted for the Belgian Bo-Bo locomotives, of which the maximum speed is 105 km h. (65 m.p.h.).

During latter years, constructors have endeavoured to isolate the motor from the track, in order that the vibrations set up by the track are not transmitted to the motors.

The motor is, therefore, fixed rigidly to the bogie frame. As it is no longer subjected to the vibrations which are particularly strong at high speeds, it can be of lighter construction though still remaining very strong. Wear and maintenance are also reduced.

These are the reasons which led to the adoption of flexibly suspended motors for the three locomotives in question. This type of suspension necessitates a spring coupling element between the motor and axle to absorb vibrations. The new Brown Boveri disc-type of transmission, described in detail in the article mentioned in the foot-note on the previous page, has been adopted for the locomotives of Swiss design.

It should be noted that it consists, in principle, of two steel discs which form a universal joint linking the motor armature to the pinion. The pinion and the large gear toothed wheel are mounted in a very rigid frame which insures perfect meshing.

The relative movements between the axle and suspended motor are absorbed by the elasticity of the discs.

The advantages of this system of transmission are that no detail is subjected to wear, lubrication is not required and it is light.

Flexible suspension and disc transmission have been selected with a view to increasing, in future, the speed of locomotives to the maximum permitted on the Belgian Railway system, whilst, at the same time, protecting the motors against detrimental vibration.

This transmission has been used since 1944 by the Lötschberg Railway (Switzerland) on their two first locomotives which have already run entirely satisfactorily more than 500 000 km (310 000 miles). Two other identical locomotives were put into service in 1948.

Characteristics and principal dimensions.

Current	D. C.
Voltage at contact lines :	
(Average).	3 000 volts
(Maximum)	3 600 volts
Track	1 435 mm (56.49 in)
Number of motors . . .	4
Gear ratio	1 : 2.05 (42/86) (modulus 12)
Type of transmission . .	Brown Boveri disc.
Diameter of driving wheels when new	1 350 mm (53.15 in)

General dimensions :

— Length over buffers. .	16 300 mm (629.92 in)
— Total wheel base . . .	11 600 mm (433.07 in)
— Bogie wheel base . . .	3 500 mm (118.11 in)
— Distance between bogie pivots.	8 000 mm (314.96 in)

Power output of one motor :

Hourly output	526 kW = 715 HP
Hourly current	384 A
Hourly speed	415 r.p.m.
Continuous output . . .	445 kW = 605 HP
Continuous intensity . . .	320 A
Continuous speed	440 r.p.m.
Separate ventilation.	
Specifications	AIEE

Output of locomotive :

Hourly output at wheel rim	2 800 HP
Hourly speed	51 km/h (31 m.p.h.)
Hourly tractive effort . .	15 t
Continuous output at the rim	2 340 HP
Continuous speed	54.5 km/h (33.8 m.p.h.)
Continuous tractive effort.	11.5 t
Maximum speed	125 km/h (77 m.p.h.)
Maximum tractive effort on starting	23 t
Average tractive effort at starting, using the total power output	20 t approx.

Fig. 1 shows the *principal dimensions*, over-all length, wheel base of bogies, etc.

Motors.

As mentioned previously, the motors are arranged in two groups of two, coupled permanently in series. They are built for a voltage of 1 500 V, and they are insulated for a service tension of 3 000 V and an effective test tension of 8 700 V. They have 6 poles. To reduce the voltage between the collector shoes, the motors are equipped with two collectors in series. The result of this arrangement is a greater security against overheating at high speeds.

Each motor weighs 5 530 kg (11 696 lbs.) without transmission and 6 574 kg (14 493 lbs.) with transmission complete, including gearing, which corresponds respectively to 8.8 or 11 kg per HP (19.137 or 23.92 lbs. per HP) in continuous rating. These weights are very low, if it is borne in mind that approximately 20 years ago, the motors of the Bo-Bo locomotives weighed approximately 80 kg per HP (172.56 lbs per HP). The progress made can, therefore, be judged.

Control system.

The weight of the locomotive has been reduced as much as possible. As has been said previously, an endeavour has been made to use the maximum adhesive weight. It is, therefore, necessary to prevent all sudden variation in the tractive effort which could bring about the slipping of one or more axles. Therefore, a very large number of starting notches, that is to say, 29 in series and 29 in series-parallel, has been provided.

The transmission between the two couplings is made by the bridge method and the passage of series to series-parallel is carried out without reducing the tractive effort.

The resistances are short-circuited or put into circuit by means of 28 cam contactors, arranged one beside the other, forming the starting controller. Seven other cam contactors form the combiner, which permits the coupling in series and series-parallel. Finally, 8 contactors from the controller for weakening the field which is carried out in four steps up to 71 % of the normal value of the field.

The cams which actuate the contactors of the various coupling apparatus are mounted on a shaft worked by an electric servo-motor. The functioning of the

contactors is thus determined accurately without any other locking arrangement being necessary.

The electric control enables very high speed to be obtained during shunting, in spite of the large number of starting notches.

The contactors are controlled automatically. Passing from one step to another is only possible when the starting current is no greater than a certain value which can be regulated, controlled by the acceleration relays.

The control apparatus allows working at the speed of 8 steps (maximum of 10) per second.

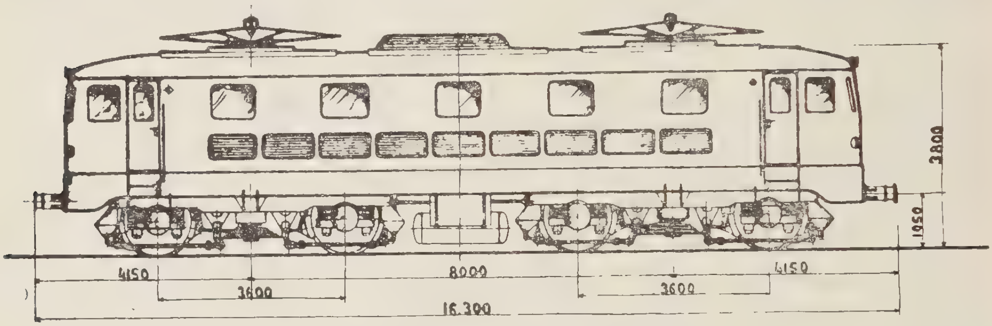

Fig. 1. — Electric locomotive. — Type Bo-Bo — 2 800 HP.

Description.

Type of current	D. C.
Voltage	3 000 volts
Number of motors	4
Total hourly power output.	2 800 HP at 51 km/h (31 m.p.h.)
Gear ratio	1 : 2.05
Type of transmission	Brown Boveri disc.
Wheel diameter	1 350 mm (53.15 in.)
Maximum speed	125 km/h (77 m.p.h.).
Weight of the mechanical portion	43 200 kg (95 240 lbs.)
Weight of the electrical portion	39 500 kg (87 080 lbs.)
Total weight of the locomotive	83 000 kg (183 000 lbs.)

The four reversers can be actuated, when current is not available, by means of a pneumatic control arrangement. They have 3 positions : front — back and neutral, isolating the motor completely. If one or two motors are out of action, it is possible to work with reduced output on the series coupling only.

The pilot controllers placed in the drivers' cabs each have a handle for working the reverser, a wheel to govern the starting controller and combiner and, finally, a handle for the controller for weakening field.

This high speed calls for acceleration relays which react very rapidly.

Independently of this very rapid automatic system, it is still possible to operate the coupling apparatus step by step under the control of the driver. In this case, the starting current still remains under the control of the acceleration relays.

The groups of cam contactors for starting can be hand operated when necessary.

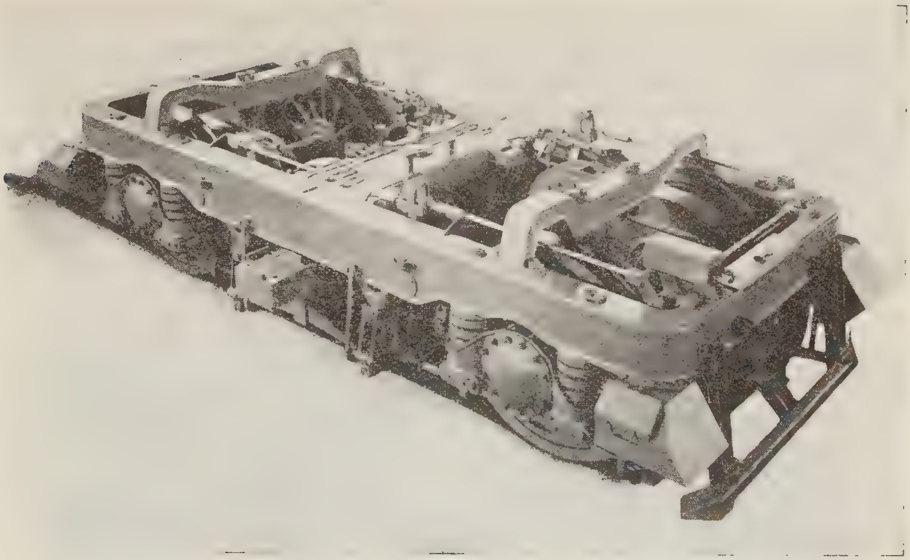

Fig. 2.

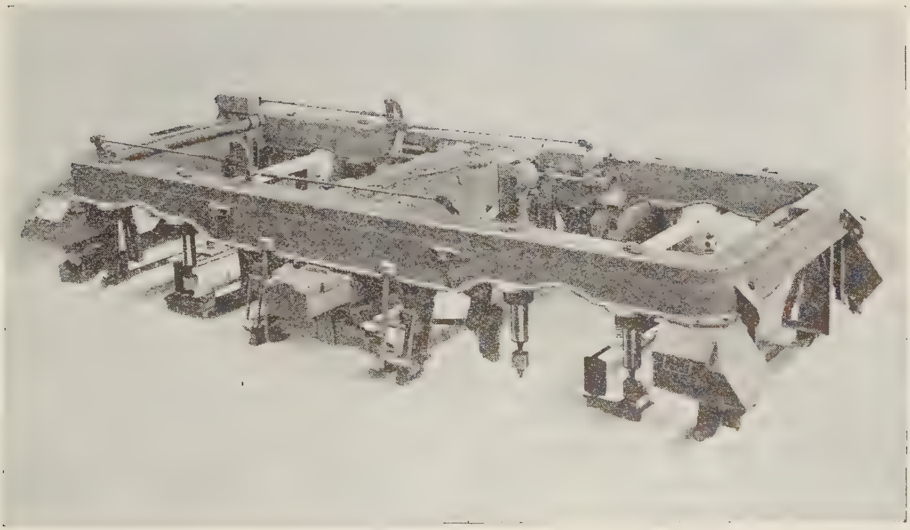

Fig. 3.

Mechanical portion.

The whole of the mechanical portion has been built in the F. U. F. workshop at Haine-Saint-Pierre. The bogies and body supports were specially designed by the Swiss Locomotive and Machine

Manufacturing Co. at Winterthur (SLM) and adapted to present requirements by the F. U. F. Co. In the afore-mentioned article by Mr. HUG, the bogie has been described on pages 685 and 686 of the November 1948, issue of the *Bulletin*. The following illustrations give some views of the construction of the locomotives at Haine-Saint-Pierre. The various parts are briefly described as follows :

Fig. 4.

The body rests by means of two supports on each bogie bolster, the latter is carried by laminated suspension springs (See Figs. 2 and 3). These springs are attached by four suspension clips to the bogie frame.

The wheels are designed for SKF type roller bearing axleboxes. Vertical, helical springs, on each side of the axles, support the bogie frame. There is, therefore, a double spring suspension : the laminated springs under the bogie bolster and the helical springs between the bogie frame and the wheels.

The body is of the box type, formed by longitudinal solebars cross stayed. The draw and buffing gears are fixed to the body headstock. The drive transmission is by the transverse staying arrangement of the bogie frame, then by means of a central bogie pivot to the main body which, therefore, takes the whole of the tractive effort.

The forces which are perpendicular and parallel to the centre line of the track are transmitted by the central pivot but the perpendicular forces can be transmitted to the bogie bolster and, consequently, to the body as the bearing of the central pivot has side play. These lateral forces are absorbed by the suspension springs,

due to the staying of these springs. Therefore, the bogie bolster, only transmits the tractive effort and shocks parallel to the centre line of the track.

The journal-bearings of the bogie bolster and the pivot bearing are in an oilbath. The novelty of the construction is principally in the arrangement of the bogie bolster under the bogie frame and the socket placed in the side solebars of the bogie and of a bronze washer with silentblock mounting.

The bogie frame (fig. 5) is of boxe type, made up of steel plate, chamfered and welded together. The underframe has no sharp corners as these have been rounded, the welds being as much as possible in the neutral zone of the transverse section.

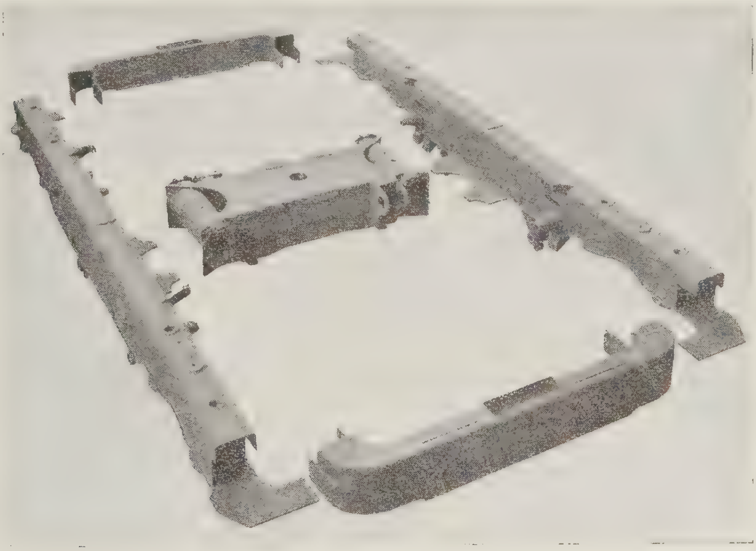

Fig. 5.

low suspension at four points of the locomotive body which is possible owing to the suspension arrangement and to the construction not being subjected to body movement.

The 2-row, oscillating, grease lubricated SKF roller-bearings (fig. 4) are situated inside the axle boxes which carry the bogie by means of helical springs.

Cylindrical guides are placed inside the springs. They consist of a guiding The traction motors are fixed as near as possible to the centre of gravity of the bogie.

In addition, a transverse coupling (fig. 6) controls the entry of the bogie into curves and insures, at the same time, a substantial diminution of the lateral guiding forces. Two guide-shafts are attached by an articulated lever to the inside corners of the bogie frame and are joined at a common point to the centre

of the locomotive. Between the two shafts, and at equal distance to each of them, there is the transverse spring coupling. The play of this coupling and the preliminary tension of the spring are regulated to the appropriate values. This arrangement tends to reduce the force and the angle of scissoring of the axles in front of each bogie, which has the effect of reducing the shocks and the wear of the flanges.

The two double brake cylinders are built into the central headstock. Each piston works the brake rigging of one wheel which is braked by two shoes. This brake rigging is equipped with a S. A. B. regulator, having an automatic arrangement for reducing play and is connected, both transversely and longitudinally, by shafts for hand control.

Eight compressed air sanders, having a capacity of 60 litres each (13.19 galls.), complete the bogie equipment of the locomotive.

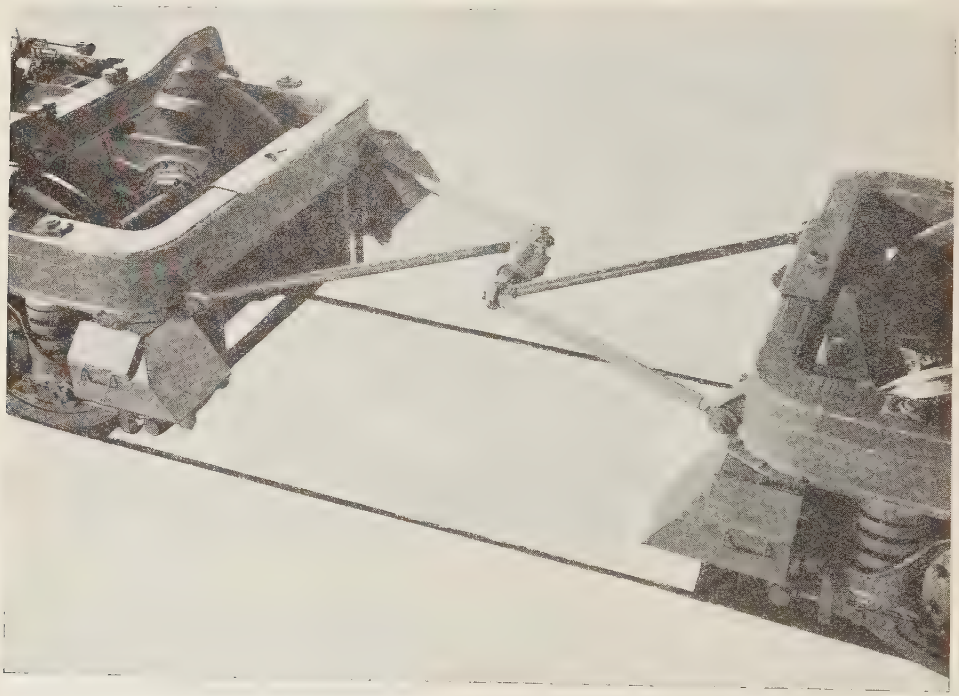

Fig. 6.

The locomotive underframe (fig. 7) is made entirely of welded plates. It consists of two tubular solebars stayed together and reinforced at both ends by two boxes made of plate welded together, carrying the draw and buffing gear. It is of robust construction as it has not only to support

the weight of the electrical equipment but also to transmit the tractive effort and shocks.

In order not to weaken the construction, the side walls are permanently fixed with openings for windows and ventilators thereby affording easy access for supervision and maintenance of the electrical equipment. The electrical equipment is separated from the corridors by protective gratings which are movable but locked in position.

Fig. 7.

only. Openings for assembling and disassembling of the electrical equipment have been located in the roof. The body is divided into three parts : a central compartment for the electrical equipment and the two driving cabs. These latter are connected by two corridors, one on each side of the central compartment,

The locomotive is fitted with the following mechanical brakes :

A. Direct Westinghouse brake for the locomotive only.

B. Automatic Westinghouse brake for braking the train.

C. Hand brake worked by a wheel

from each drivers' cab which acts on the bogie wheels corresponding to the cab.

Conclusion.

To sum up, the builders, BROWN BOVERI AND FORGES, USINES & FONDERIES, HAINE-ST.-PIERRE, endeavoured to design type of locomotive for 3 000 volt direct current which would embody the most up-to-date methods and equipment, both as regards the technique of direct current and of mechanical construction. The advantages are :

— the full utilisation of the whole weight of the locomotive as adhesive weight;

— unsuspended weight reduced to a minimum;

— lightening of bogie and body construction by the use of fabricated parts welded together;

— smooth running without shocks, especially on curves;

— large flexibility of motors due to a characteristic effort-speed corresponding to the needs of the system;

— possibility of extended field shunting;

— system of automatic and rapid starting which also enables shunting to be carried out entirely by hand, taking into account the most difficult track conditions.

[385. (06. 111]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

Final summaries adopted at the fifteenth Session (Rome, 1950).

SECTION I. — Way and Works.

QUESTION I.

Modern tendencies in the building of railway structures, especially bridges. — Results obtained in the construction of railway bridges in reinforced concrete. — Future prospects of the prestressed concrete.

SUMMARIES.

1. *General. Present design requirements. Live load. Dynamic load, provision for fatigue.*

« Other than on American Railways, « the live loadings now adopted are « reasonably comparable and it is con- « sidered that a limit has now been « reached.

« Formulae laying down the dynamic « loading, related solely to the span of « a bridge do not adequately cover all « dynamic components. The effect of « irregularities in the track, including « the effect or rail joints, should be « provided for.

« Tests are desirable.

« Special provision for fatigue effect « is made when actual reversal of stress « will occur.

« It would be advisable to determine « the effect of the eventual recovery of « the structure of the metal for slower « frequencies than those which have « been considered up to the present in « laboratory experiments.

2. *Metal bridges.*

« Decking entirely of metal is indi- « cated when there is only restricted « construction depth available. In such « a case the track is usually carried on « sleepers or cross ties, the stringers or « rail bearers are usually fixed between « the flanges of the cross girders, con- « tinuity being assured by bridging « pieces; the fixing can then be made « in a way, at least as satisfactory as « when the rail bearers are placed on « top of the cross girders.

« Welding of site connections is still « rare, but tends to be developed.

« The use of reinforced concrete « decks on metal bridges has been « adopted in recent years, in conjunc- « tion with ballasted tracks, with the « accompanying advantages.

« Metal bridges are used for the « bigger spans, for cases of limited con- « struction depth, and where provision

« must be made for settlement of foun-« dations.

« Plate girder construction is simpler « and economical up to spans of 100-« 125 ft. For longer spans lattice « girders of the simplest type are used.

« Mild steel of about 28-32 tons per « sq. inch ultimate is used widely. The « use of special steel is only recom-« mended in special cases. The use of « light weight alloys has hitherto been « limited to less important members.

« Welding has been adopted for the « construction of medium span plate « girder bridges, with success up to the « present. Only one case has been « reported of the construction of a com-« pletely welded lattice girder bridge.

« Combined steel and concrete con-« struction designed deliberately for « composite action is a solution which « might be interesting and advantageous « for simple spans up to about 100-« 125 ft. Application to continuous « girder construction involves pre-« stressing the concrete deck at the inter-« mediate piers.

« The first bridges of this type should « be kept under observation to find out « how the bond between the two « materials was affected in the course « of the time.

3. *Arch bridges, built of concrete or stone.*

« Such bridges are generally eco-« nomical, particularly in maintenance « and are preferred whenever local con-« ditions are suitable. Concrete is « widely used and is the cheaper; con-« struction in natural stone gives im-« proved appearance, but is generally « more costly; stone faced concrete is « a suitable compromise provided steps « are taken to obtain a reliable bond.

« Weak concrete is generally used for « the backing between spandril walls.

« Pin type joints are not necessary « unless the bearing of the foundations « is in doubt.

« There exists inadequate reliable « information on the precise dynamic « loading of masonry arches carrying « rail traffic, but it is likely to be less « than for metal bridges.

4. *Underbridges comprising girders encased in concrete.*

« This is a useful form of construc-« tion when construction depth is « shallow and when line occupation « facilities are limited. It involves a « somewhat extravagant use of steel, « and it is necessary to provide ade-« quate transverse reinforcement.

5. *Road bridges or over-bridges.*

« It appears that the most usual type « at the present time is the three span « reinforced concrete bridge.

« Some countries make use of pre-« stressed concrete.

« It is general practice to provide as « few piers as is reasonably possible in « the construction of overbridges span-« ning station and yard layouts.

6. *Piers and abutments.*

« Mass concrete is most widely adopt-« ed for piers and abutments. Hollow « construction is only considered for « special cases and where the intensity

« of foundation loading must be kept « unusually low. Reinforced concrete, « or steel framed piers are adopted to « reduce obstruction to visibility and « where loading gauge clearance require- « ments restrict the possible thickness.

7. *Platform roofs.*

« Both steel and reinforced concrete « are used, the umbrella type roof being « the most usual form of construction.

« Glazing is provided in most coun- « tries to meet particular local natural « lighting requirements.

« Except in the case of very severe « climates, the determination of the « sections required is made, as a rule, « by taking into account either the snow « or wind load, but not by adding them « together.

8. *Testing of structures.*

« Testing of structures covers the « following fields :

« 1° to confirm the behaviour and « capacity of a new structure before it « is brought into use;

« 2° to determine the safe load « capacity of old bridges;

« 3° to investigate special general « problems such as shrinkage, creep, « dynamic effects of live loads, etc.

9. *Reinforced concrete underbridges.*

« Slab construction is used up to « maximum spans of 20-33 ft. and in « certain cases for spans up to 48 ft.

« Lighter forms of construction, using « T. beams or hollow beams, have « enabled longer reinforced concrete « spans to be built, particularly in con- « tinuous construction and with variable « moments of inertia.

« For long span bridges, arch con- « struction lends itself more effectively « to the rational use of reinforced con- « crete.

« Not only should high strength be « aimed at, but the concrete should be « as nearly waterproof as possible and « there should be a minimum of shrink- « age.

« Care should be taken to provide « reinforcement in all parts of the struc- « ture where tension stresses occur, even « if these stresses have not been taken « into account in the design.

10. *Pre-stressed concrete.*

« Pre-stressed concrete construction « has already been used on several rail- « way systems, but as yet, in only a few « cases for underbridges of spans not « greater than about 36 ft. carrying « usual main line loading, and 60 ft. « carrying meter gauge loading.

« At present, pre-stressed concrete « lends itself to mass production of « similar units, it also enables shal- « lower construction to be adopted than « when using ordinary reinforced con- « crete. It is hoped that its use will « also be accompanied by reduced main- « tenance.

« Its field of application will be « extended when higher working stresses « in the steel and concrete can be « adopted with confidence.

« There is need for more information « on certain technical details relating to « the practice and application of pre- « stressing of concrete. »

QUESTION II.

Rail-joints : improvements in fishplated joints. — Use of long welded rails : optimum length in relation to the safety and good condition of the permanent way. — Expansion gaps. — Determination of standard allowances.

SUMMARIES.

FIRST PART.

Fishplated rail joints.

« 1. It is apparent from a study of « the reports received that there has « been no considerable modification to « the traditional fishplated joint, which « consists of two fishplates, short or « long, strengthened to varying degrees « by lower or upper ribs, and held in « place by bolts through the web of the « rail. Complicated arrangements to « provide a continuous running surface « to the rail at the joint are not found « in use to give the advantages hoped « for by their inventors. Slant cutting « of the rail ends is not favoured in « current practice.

« 2. To avoid excessive fatigue in the « constituent parts of the joint it is usual « to reduce the sleeper spacing adjacent « to rail ends. The most general prac- « tice is to support the rail on two « independent sleepers, closely spaced, « to allow of adequate packing in pre- « ference to a double sleeper. As to the « joint supported on a single sleeper, « this now seems to be falling into « disuse, except in the U. S. A. and in « India, where from information receiv- « ed it is still widely practised.

« 3. The most general arrangement is « for joints to be opposite each other. « Whilst the use of joints out of square « or staggered by half a rail length con- « tinues to be employed in some in- « stances on sharp curves to assist in « the maintenance of alignment, the use « of staggered joints elsewhere which « was once fairly frequent practice has « gradually fallen into disfavour, proba- « bly because of the rolling which they « induce in rolling stock on tracks « where the rail length is comparatively « short. On modern track, however, « with longer rails it would seem that « better results can be obtained from the « use of staggered joints, and it would « be of interest, therefore, to renew « experiments in this direction.

« 4. From the reports received, there « does not seem to be any advantage in « equating the section modulus of the « fishplates with that of the rail.

« 5. To allow expansion at the rail « ends, the holes in the fishplates and « the rail must be larger than the dia- « meter of the fishbolts.

« Up to the present the general prac- « tice has been to make larger holes in « the rail than in the fishplate, to mini- « mise the weakening of the latter. On « the other hand, it would seem that the « adoption of smaller holes in the rail « would reduce the risk of cracks which « often commence at fishbolt holes; the « use of oval holes in the fishplate would « then allow the vertical dimension of « the holes to be kept to a minimum.

« 6. The use of fishbolts of a rela- « tively small diameter not only avoids « having large holes in the rail and « fishplate, but also makes the maximum

« possible use of the elasticity of the « metal of the bolt.

« 7. It does not seem advisable to « support the joint by means of a fish- « plate formed to act as a bridge.

« 8. The surfaces by which the fish- « plate makes contact with the head and « the foot of the rail must be inclined « to give a wedge effect and to allow « for the taking up of wear. The most « common practice is for the fishing « angles to have an inclination of one « in three at both the head and the « foot of the rail.

« Some systems have adopted an « inclination of one in four, others a « steeper inclination up to one in two, « and sometimes the inclination differs « at the head from that of the foot. « There do not seem to be any parti- « cular advantages, however, in these « variations.

« 9. Fishplates are generally made of « ordinary rolled steel, having an ulti- « mate tensile strength slightly less than « that of the rail. Some systems employ « heat treatment but this practice does « not seem to be increasing. The tests « specified vary somewhat but offer no « points of special interest and it is « assumed that existing specifications « give satisfaction.

« 10. Perfect alignment of running « surfaces of the two rails meeting at « the joints is of great importance. It « is desirable therefore that rails should « be correctly matched when they are « laid, and if possible rails from the « same ingot should be placed together. « The so-called « perfect » joint of the « Belgian Railways is of great interest, « but on account of the subsidiary weld- « ing which is involved it is fairly costly, « except where serviceable rails are « used.

« 11. Correct alignment of running « surfaces of the rails in service can be « obtained by shims of appropriate « thickness inserted between the fish- « plates and the head of the rail at the « fishing angles. Specially forged and « cambered fishplates (hog-backed) are « useful for this purpose, but are less « exact.

« 12. The more rapid wear at rail « ends, resulting from wheel impact, « produces battering and burring over « of the top surface. Some systems « chamfer the rail ends so that burrs « do not from too quickly. Ends can « be built up by welding to restore a « smooth running surface and to allow « rails to remain longer in the track. « Hardening of the metal by a suitable « heat treatment can be expected to « reduce these troubles at rail ends « provided no appreciable brittleness « results.

« 13. The use of spring washers to « prevent slackening of fishbolt nuts is « likely to have appreciable effect in « reducing the labour of maintenance.

« There does not yet seem to have « been close investigation of the possi- « bilities of the elastic fishplate. Where, « however, fishplates with spring exten- « sions at the ends have been used, « useful results seem to have been « obtained.

« 14. Careful attention to the level of « joints increases their life. It is gener-

« ally recognised that joints should be « attended to more frequently, than the « rest of the track, the frequency of « such attention being a function of :

« the nature of the formation;

« the density of the traffic;

« the speed of the trains.

« Systematic packing of joints with « small size stone ballast appears parti- « cularly satisfactory.

« 15. Insulated block joints present « difficulties which can be reduced by « the use of fishplates made entirely of « insulating material with sufficient « mechanical strength; up to the present « bakelised wood seems the only mater- « ial to give reasonable satisfaction.

SECOND PART.

Long welding rails.

« 16. It has been learned from « experience that rails of a length up « to 300 ft. can be laid in the open in « main lines without special provisions « for expansion.

« 17. Opinion is divided on the « necessity to provide special devices « for fixing rails to sleepers. It is quite « evident that the rails must either be « permanently held down tightly or « must be fixed by a spring device which « creates a permanent pressure between « the rail and the sleeper.

« 18. The number of sleepers per « mile, on tracks with long rail lengths, « varies considerably on different sys- « tems. Some consider that it is advis- « able to adopt a rather close sleeper « spacing.

« 19. Neither anti-creep devices nor « rail anchorages to the formation « appear to be necessary to avoid creep « of long rails.

« 20. The sleeper spacing at welded « joints can be the same as in the centre « of the rails.

« 21. In station sidings rails up to « 330 ft. long can be laid in the ordin- « ary way and no special precautions « are necessary in regard to the attach- « ment to sleepers or the fishing at « joints.

« 22. In tunnels, where temperature « variations are small, the rails can be « welded from one end to the other. « There does not seem to be any need « to employ gradually reducing lengths « of rail between the long welded lengths « and the normal track in the open.

« 23. The material and the cross sec- « tion of the ballasting of tracks with « long welded rails is of great import- « ance; to preserve alignment, parti- « cularly on curves, a good shoulder of « ballast at the ends of the sleepers is « essential.

« 24. Some systems have already « carried out tests in the open with rail « lengths of several hundred yards, and « obtained encouraging results; it is « most desirable that such tests should « be continued on a wide scale. The « elimination of impact at rail joints is « certainly a source of considerable « economy both in maintenance of track « and rolling stock, it also adds con- « siderably to comfort. The use of long « rails also gives the advantage of faci- « litating the staggering of joints.

« 25. It should be possible in the « near future to determine from exper- « ience the type of joint to be employed « for joining long rail lengths together, « or connecting these to junction work « and insulated block joints, etc.

« 26. Theoretical studies and the « tests which have been made give vary- « ing results for the stresses in the rail « and the resistance of the track as a « whole to these forces. It would be « advantageous if these studies and « experiments were continued on a « uniform basis with common and well « defined terms, so that the results could « be easily compared. These should be « concentrated on the actual stresses in « the rails at different temperatures « with different types of track. It « would also be useful to find out by « experiment the maximum resistance « which different types of permanent « way and ballast can develop against « movement as a result of the stresses « in the rail. Such studies and tests « should enable a decision to be made « as to the best temperature at which « long rails should be laid.

THIRD PART.

Rail gaps in relation to temperature.

« 27. The general experience acquir- « ed is that the gaps between rails can « be less than those theoretically cal- « culated on a free expansion basis—in « fact they can be reduced to a half or « even less. The more the type of track « resists creep, the smaller the gap « can be.

« 28. Unless special arrangements « are made for the joint, this is a weak « point in the track which may be the « focal point of a buckle. It is therefore « important that the space allowed for « expansion, having regard to the type « of track concerned, is not all taken up « at too low a temperature, otherwise « there is risk that excessive forces will « arise in the rail. In the course of « maintenance work, and particularly « before the first hot weather of the « year, the rail gaps could be restored « to normal. Examination should be « made to ensure the fishplates will « allow the rail ends to move freely. « This might involve for example the « unscrewing or the screwing up of the « fishbolts.

« It is, however, permissible to allow « some tolerance in the gaps compared « to that provided at the time of laying.

« 29. Checking of joint gaps should « be done at times of day when the « temperature is not particularly high. »

QUESTION III.

New technical methods adopted for the design and construction of large marshalling yards.

Lay-out and equipment:

Site and importance of siding groups;
Lay-out of connections at entrance to groups;
Longitudinal and cross sections;
Braking installations (Retarders);
Control of point (switch) operation;
Telecommunications;
Lighting;
Staff buildings, etc.

SUMMARIES.

General.

« 1. The methods adopted in the

« design and construction of marshalling « yards are based on the fundamental « principles laid down at the Congresses « of London (1925) and Madrid (1930); « they aim at increasing efficiency, « reducing costs and enlarging shunting « capacity by the application of « me- « chanisation » and the planning of « rational lay-outs and profiles.

« 2. Each new scheme presents a « particular problem, from the points of « view of cost of construction and eco- « nomy in working. It is desirable that « the study of schemes should be « advanced as far as possible by com- « petent staff of the using department « before constructional plans are pre- « pared (commenced).

« 3. The modernisation of existing « yards, often situated in congested « areas, may present difficulties of reali- « sation owing to the want of available « space.

« 4. The construction of new yards « and, eventually, of the necessary loco- « motive depots, involves the finding of « suitable sites from the point of view « of superficial area and contour; when « the sites selected are remote from « populated areas, it is necessary to « consider means of transport, and « housing accommodation for staff.

« 5. Except where special cases or « local circumstances render all other « solution impracticable, the construc- « tion of double yards, comprising two « yards, side by side, each dealing with « an opposing flow of traffic, is justi- « fied only when the number of vehicles « to be dealt with exceeds the capacity « of a single hump yard.

« 6. Yards on the gravitation prin- « ciple, wholly or partially, are only « constructed where a suitable profile « exists or can be made.

Location of groups of sidings and connecting lines.

« 7. In addition to reception and sort- « ing groups, which are usually laid out « in sequence, large yards should have « separate marshalling and departure « groups, also storage and lay-by faci- « lities as necessary.

« From the point of view of operat- « ing convenience, and expeditious « transfer movements of vehicles, it is « recommended that the following be « provided :

« departure groups in continuation of « the sorting group;

« marshalling group and recess lines « at the sides of the sorting group.

« 8. The number of sidings in the dif- « ferent groups and their effective length « are decided by the department res- « ponsible for operating, according to « service requirements, taking into con- « sideration future developments and « having regard to the space available.

« 9. The arrangement of communi- « cating and connecting lines, and the « siting of the leads of the groups of « sidings should be studied with the « object of facilitating the movement of « trains and locomotives so as to reduce « to the absolute minimum interference « between trains, locomotives and shunt- « ing operations. In these circumstances « constructional works should be under- « taken in order to eliminate the more « restrictive cross-movements.

« 10. The risk of interference between shunting operations and trains « can be appreciably reduced by the « provision of independent facilities; at « large yards the provision of direction « reversing loops or equivalent facilities « permits, in conjunction with the use of « departure groups, of oneway working « which facilitates operation.

« 11. The layout at the heads of the « groups of sidings should be as simple « as possible in order to reduce the « length of shunt.

« The provision of two lines over the « hump at the same level enables an « appreciable reduction to be made in « the length of the head of the reception lines nearest to the hump; it also « affords the possibility of more continuous shunting when two humping « locomotives are employed.

« On the other hand humping lines « at different levels (winter and summer) « have the disadvantage of lengthening « the layout and the length of shunt. « Moreover they are unnecessary when « the yard is equipped with railbrakes.

« 12. Subsidiary facilities should be « incorporated for accommodating brake « vans, locomotives, for the rapid « repairs to vehicles and for re-adjusting « displaced loads. These installations « should facilitate working, but their « existence should not, in any case, constitute a source of slowing down the « flow of the sorting and geographical « marshalling operations.

Construction (Layouts, levels, profiles).

« 13. It is recommended that the « heads of siding groups should be very « compact, adopting for the layout curves of minimum radius compatible « with free movement of locomotives « and vehicles.

« It is advisable to use for this purpose specially designed permanent « way, particularly short symmetrical « two-way leads.

« 14. It is desirable that in the body « of the groups the sidings should be « of straight alignment; the distance « between sidings is determined so as « to ensure the safety of staff working « in the spaces between them.

« 15. Considerations of economy in « installation and maintenance generally « justify the use of recovered serviceable rails in the body of the siding « groups and new rails of the type standard for main lines in the heads of « the groups. In order to reduce the « number of joints, rails in the body of « the sidings are sometimes welded.

« 16. Ballast, the nature of which « depends upon local or other sources « of supply, is generally placed on an « underbed of permeable material. « When the nature of the group necessitates it, a drainage system ensures « the removal of surface water.

« In track circuited areas, particular « attention should be paid to ballast and « drainage.

« 17. The reception group is constructed on a fairly level gradient, a « short rising gradient approaching the « hump being provided in order to permit the uncoupling of vehicles.

« It is possible, in order to reduce « earthworks, to allow an appreciable

« gradient between the reception group « and the hump without however « exceeding the capacity of the locomo- « tives employed for hump shunting.

« 18. The relative levels of the hump « and the sorting groups depend upon « the drop necessary to ensure under all « conditions the separation of vehicles « by gravity.

« 19. In order to ensure rapid separa- « tion of cuts, the radius of the vertical « curve of the hump should be small; « further the profile between the hump « and the head of the sorting group « should be hollow and should include « a steep initial gradient.

« After this gradient, the profile « should be such as to ensure in all « instances adequate spacing of vehicles « up to the braking zone. The brakes « are established on a falling gradient in « order to liberate easily vehicles which « may have been stopped there.

« 20. The switching area beyond the « railbrakes should be on a slightly fall- « ing gradient or on the level — the « gradient being then sufficiently reduc- « ed to prevent acceleration of good « running vehicles.

« A level profile may permit, with « experienced brake operators, of in- « creasing the rate of shunting because « it is necessary that the vehicles should « have an appreciable velocity at the « outlet from the brakes, with the object « of increasing the distance between « successive cuts, thus reducing the risk « of overtaking.

« 21. It is recommended that the « longitudinal profile of the sorting « group should be slightly hollowed — « the ends presenting suitable gradients « intended to facilitate the running of « vehicles without risk of inopportune « acceleration.

« Steeper gradients should be pro- « vided on the outer sidings in order to « compensate for curve resistance — the « cross profile being thus slightly cam- « bered.

Railbrake and switching control.

« 22. The technical development of « equipment at large marshalling yards « has been characterised in recent years « by the increased use of railbrakes.

« The design of railbrakes has been « improved, in order to facilitate main- « tenance and reduce costs correspond- « ingly, and, in certain countries, to « overcome difficulties resulting from « important variations in the width of « wheel tyres.

« 23. With the object of keeping « down the cost of equipment, it is pos- « sible to be satisfied with the installa- « tion of one set of railbrakes both for « interval and distance braking; each « railbrake generally serving a fan of « eight sidings.

« 24. In installations of this type, the « railbrakes can be operated by one « man, located at the side at the head « of the sorting group; supplementary « braking of vehicles which have not « been retarded sufficiently by the rail- « brakes is effected by means of either « hand brakes on the vehicles, or by « shoes manually placed, or possibly by « mechanically operated shoes.

« 25. The movement of switches by « quick acting motors controlled by « track circuit or other equivalent apparatus, facilitates the work of the switch « operators; it enables economies in staff « to be made and increases the shunting « capacity of the yards.

« 26. Apparatus for the automatic « control of switch operation enables the « rate of shunting to be increased. « Their employment has become general « and it has even been extended to yards « not equipped with railbrakes.

« 27. Automatic switch control must « enable the routes of several wagons « to be recorded; it can be applied either « at the head only of the switching area « or throughout. In the latter instance, « it is possible to dispense with a switching operator for the sorting sidings « provided that devices can be incorporated to avoid incorrect routing of « succeeding cuts in the event of one cut « overtaking another.

« 28. Some Administrations include « in the automatic switch operating system a storage apparatus which enables « successive routes for the different cuts « to be stored before the commencement « of shunting.

Auxiliary equipment (communications, lighting, buildings).

« 29. Electrically controlled indicators, or teletype apparatus, enable « hump posts to indicate to the brake « operator, and simultaneously to the « switch operator, where employed, the « destination and the nature of each cut; « in certain instances such apparatus « has avoided the necessity for the preparation of « cut » lists.

« 30. Out-door loud speakers are the « most practical and most used means « for the transmission of orders to the « yard staff; « talk-back » loud-speakers « give the same facilities by means of « two-way communication.

« Liaison between the shunting control points and the yard staff can « likewise be effected by means or portable radio apparatus.

« 31. Communications between « shunting control posts and humping « locomotives are usually given by « mechanical signal or for preference by « the illuminated type of signal.

« These signals should be repeated « as necessary in elongated yards and in « those yards worked by two locomotives.

« At certain modern yards these « signals are supplemented by apparatus « in the driving cab of the shunting locomotives, cab-signals, carrier waves, or « radio.

« 32. Wireless, which can be « one-way » or preferably « two-way » is « developing progressively because it « affords more complete and precise « intercommunication.

« It appears desirable in order to « provide for the future, that the Railway Administrations should have the « necessary wavelengths allocated to « them by the appropriate authorities.

« 33. The economy of night operation depends upon the character of « the illumination provided; this should « receive special attention in the zones

« of intensive shunting or of movements « in the zones of centralised switch and « brake control posts.

« Many administrations consider that, « except in the case of yards subject to « frequent fog, it is advantageous to « use powerful lights fixed at a consider- « able height; oblique lighting (flood- « lighting) by projectors enables a reduc- « tion to be made in the number of sup- « ports and to place them outside the « siding groups.

« 34. The control posts for the « switches and railbrakes, which are « always provided with illuminated dia- « grams, should be sited and arranged « in order to ensure the best visibility « of the ground; they are generally ele- « vated and provided with large bay « windows and awnings.

« 35. Apart from the different build- « ings which it is an advantage to group, « each yard requires a principal admi- « nistrative and supervisory building « which is generally installed at the main « centre of operation. »

SECTION II. — Locomotives and rolling stock.

QUESTION IV.

The comfort of passengers in coaches, railcars and electric motor coaches:

Sound proofing;
Lighting;
Heating, air conditioning, ventilation, thermic isolation;
Upholstery;
Running stability (type of bogie and suspension).

SUMMARIES.

A. Sound insulation.

« 1. The experiments carried out by « different railways prove that elastic « wheels do not lead to any appreciable « improvements from the point of view « of the sound insulation of vehicles. « Such types of wheels can even be the « source of parasitic vibrations in them- « selves.

« 2. It is possible to reduce the for- « mation of noise by:

« — simplifying the brake rigging « and doing away with a central rigging;

« — providing suitable guides for all « the moveable parts of the body;

« — covering the body sheets with « absorbant substances and reducing the « size (area) of sheets used;

« — using helicoidal gears in the « drive of railcars and ground gears for « rail motor coaches.

« 3. The use of anti-vibration pack- « ings between body and bogie is very « widespread.

« 4. The suspension of the heat « engines is always completed by very « elastic rubber packings.

« 5. In the construction of up-to-date « rolling stock, extensive use is made of « absorbant substances on the walls, « floors, ceilings and doors.

« Such substances provide satisfactory

« heat insulation. The latter is com« pleted, in very cold countries, by the « use of double windows.

« 6. There is a tendency to equip rail« cars with a platform or luggage com« partment between the compartments « and the driving compartment.

« 7. The transmission of noise can be « reduced by carefully packing the trap« doors in the floors and the holes for « the pipes and conduits.

B. Lighting.

« 1. Up to the present incandescent « lamps have been widely used. Fluor« escent lighting is now developing very « rapidly.

« 2. At the present time the filaments « of incandescent lamps are screened by « using either opaque bulbs or opaline « diffusers.

« 3. For some years there has been « an appreciable increase in the amount « of light provided (90 lux in 1st and « 2nd class; 50 lux in 3rd class at read« ing level). With equal power install« ed, the lighting can be tripled approxi« mately by the use of fluorescent « tubes.

C. Heating. — Air conditioning. Ventilation. — Heat insulation.

« 1. With steam heating, there is a « general tendency to increase the feed « pressure in the main steam pipe in « order to improve the heating of the « last few vehicles of the train.

« 2. In the corridors of compartment « coaches, the steam or electric radiators « are arranged either against the body « sides or against the compartment par« titions, or in the compartments them« selves. Some railways use the actual « steam conduit as a radiator for heating « the corridors.

« 3. Direct electric heating by radia« tors is the most widely used and most « economical method. It gives satis« factory results provided the circulation « of air around the heating elements is « adequate.

« 4. Pulsated air electric heating « increases the comfort, and also makes « it possible to ventilate the vehicles « during the summer. However, the « consumption of current in high and « low tension is much higher than with « direct heating.

« 5. There is a general tendency to « adopt heating of compartments indi« vidually, with thermostatic control.

« 6. In railcars, heating by the engine « cooling water or exhaust gases does « not usually give sufficient comfort. « On both vehicles and trailers the pre« sent tendency is towards the use of « coal or oil systems of heating. In the « latter case, the working can easily be « made automatic.

« 7. Coaches not equipped with air « conditioning or pulsated air heating « are nearly always equipped with ven« tilators in the ceilings or walls. A few « applications of forced ventilation have « also been carried out.

« 8. Air conditioning is in general use « in the U. S. A. and in tropical coun« tries. In Europe, it has only been « tried to a very limited extent.

« 9. In coaches equipped with air « conditioning with cooling equipment, « use is always made of double fixed « windows.

D. Fittings.

« 1. In coaches of European con- « struction, the seats always face each « other, whilst in America, Australia « and Africa they often face in the same « direction, and can generally be revers- « ed and have adjustable backs. It « may, however, be noted that trials are « being undertaken in Europe with « adjustable and reversable seats.

« 2. In Europe, springs and hair are « used to upholster the seats. In Ame- « rica, Australia and Africa, sponge rub- « ber is also used.

« 3. The use of leather or similar « synthetic products has been greatly « extended for seat coverings, except in « cold countries and in Europe, where « particularly in first and second classes « textile materials are still widely used.

« 4. Head and elbow rests are still « used in 1st and 2nd classes and also « in third class in certain countries.

« 5. There is a definite tendency to « provide upholstered seats in 3rd class, « as well as seats that can be turned into « berths on coaches making long runs.

« 6. The central corridor is almost « general practice in the case of stop- « ping train coaches and also for railcars « and rail motor coaches, except on « British Railways where the practice is « to provide central corridor and also « non-corridor stock.

« 7. In Europe the main line stock « often has a side corridor, whilst in « America, the centre corridor is the « most common.

« 8. In Europe, there are 3 seats a « side in 1st class, 4 and sometimes 5 « in 3rd class. There are 3 or 4 seats « a side in 2nd class.

« 9. In all American coaches and in « general in railcars and in rail motor « coaches, there are 4 seats a side.

« 10. Plywood or composition mater- « ial (Masonite) is widely used to cover « the walls. Special coverings of plastic « materials are also being used.

« 11. The floors are generally cover- « ed with linoleum, and more rarely « rubber. These materials are some- « times covered by a carpet in 1st class.

« 12. The walls of W. C.s are cover- « ed with painted, enamelled or vitrified « sheets. There are also some examples « of rustless steel being used, or ply- « wood covered with plastic materials.

« 13. The floors of W. C.s are in « mosaic or earthenware tiles, in rubber « with coverings, special asphalt or « cement, or metal grills.

« 14. Hot water for washbasins in the « W. C.s is beginning to be provided « more generally, especially during the « winter.

E. Stability of running.

« 1. Most Administrations continue « to use the classic types of bogies on « their up-to-date stock as previously « standardised.

« 2. Such bogies can be used for very « high speeds provided that special con- « ditions of maintenance are observed « for the stock and that the track is in « a good state.

« 3. Bogies of special types for ordin- « ary and high speeds have recently been « tried and seem likely to be generally « used on the future rolling stock of « some railways. However, in the « design of bogies other factors than the « comfort must also be taken into « account (cost, weight, ease of main- « tenance).

« 4. The use of bogies without swing « bolsters has been very limited to date, « and is not likely to be made general.

« 5. An increase in the flexibility of « the springs is likely to improve the « comfort: It may also be necessary on « account of the lightening of rolling « stock, plate springs, coiled springs or « a combination of the two types « remaining current practice. The use « of coiled springs is extending com- « pared with that of plate springs.

« 6. The use of torsion bars is not « very extensive. Rubber is used more « and more for auxiliary springs but not « often for the main springs.

« 7. Some railways check the damp- « ing out of the vertical and horizontal « oscillations, either by combining dif- « ferent types of springs or by hydraulic « shock absorbers.

« 8. For high speed rolling stock, « there is a general tendency to reduce « the play in the axle box guides, either « by using special materials, or by spe- « cial designs of guides without play.

« 9. According to certain railways, « the reduction of the coning of tyres « makes it possible to improve the com- « fort by reducing hunting. This meas- « ure however results in increased wear « of the flanges. »

QUESTION V.

Improvements in the construction of rolling stock (motor and trailer) in view of increasing the mileage between repairs:

- **solid wheels or with tyres (metal used for the tyres and solid wheels, behaviour in service);**
- **axle boxes;**
- **wearing and friction metals;**
- **springs (qualities, shape, manufacture).**

SUMMARIES.

« 1. *Tyre wear* determines generally « the mileage between repairs to the « running gear and frame.

« *Modern equipment,* that is, the « stock provided with the improvements « mentioned in the Report, has made it « possible to extend the mileage between « repairs with a more intensive utilisa- « tion and in certain cases an increase « in load and speed.

« *New rolling stock* is ordered for « various reasons: saving in working « costs, higher speed, greater safety, « more comfort. The saving in main- « tenance costs, whilst not the overriding « factor, enters into these reasons.

« 2. *One piece wheels* have been « tested by many Administrations. They « avoid tyre movement and in the case « of carriages, railcars and motor « coaches, the wheels can be lightened.

« The information on cost price of « these and tyred wheels does not agree. « It has to be remembered that the ser- « vice conditions are different. Heat « treating of the tread is advised to get « at least the mileage of tyred wheels or « better, to exceed it. Increasing the « resistance to wear and ultimately the « possibility of repairing the root of the « flange by welding seem to be two « benefits more readily obtained with « one piece wheels. It appears desir- « able that the experience with one piece « wheels be followed up.

« 3. To increase the mileage between « repairs and reduce wear with harder « rails some railways use *tyres* of 90 « kg/mm² (57.14 tons per sq. in.) qua- « lity.

« *Lubrication of the flanges or the* « *rails* is desirable to reduce the reci- « procal wear of these two parts. Most « Administrations carry the lubricator « on the engine. Many and various « arrangements are used.

« 4. Trials of independent wheels « which have been carried out by several « Administrations (L. M. R. of the « British Railways, Italian Railways, « Swiss Federal Railways) have often « given rise to rapid and irregular wear « of wheels of this type when used as « guiding wheels. Definite conclusions « regarding the advantage of indepen- « dent wheels would require trials under « other arrangements than those out- « lined in the Report.

« 5. *Roller bearing boxes* tend to be « increasingly used in view of the reduc- « tion in hot boxes and the saving in « maintenance. In the case of steam « locomotives, the use of these boxes on « the driving and coupled axles or on « the driving axles only provides a « reduction in wear, resulting in an « important increase in mileage between « repairs.

« The few incidents reported in con- « nection with the journals can be « ascribed to these journals being too « small.

« In view of the high price of roller « bearing boxes, there are cases wherein « other types of box can be preferred.

« *When roller bearings are fitted* « *to electric locomotives and motor* « *coaches,* devices to prevent the electric « current from passing through the rol- « ler bearings are generally fitted.

« 6. Amongst oil axle boxes other « than of the classic type, should be « noted the boxes with mechanical oil « circulation, and on steam locomotives, « boxes with two brasses completely « surrounding the journal (British Rlys. « (S. R.) and S.N.C.F.).

« Lubricator pads of oil axle boxes « are improved by increasing the num- « ber of wool wicks and the use of wool « of special qualities.

« The tendency in Europe is to use « high tin *antifriction* metal for high « speed locomotives and rolling stock. « Rose metal or lead copper (Cu = 69, « Pb = 30, Zn = 1) is widely used on « the Italian State Railways on goods « wagons.

« These latter years, the tendency has « been to use thin coatings of white « metal not exceeding 3 mm (1/8″) « thick, but it is noted some Administra-

« tions are going back to a rather greater « minimum of 5 to 7 mm (13/64″ to « 9/32″).

« 7. The upkeep of parts *subject to* « *wear* is generally done by using detach- « able wearing plates.

« Interesting results have been re- « ported :

« 1°) for articulated joints in general « and in particular for brake rigging by « the use of hardened or case-hardened « steel bushes;

« 2°) for axle box guides by the pro- « vision of the following :

« use of 13/14 % manganese steel « (*British Rlys.*);

« use of plastic materials (*Italian State* « *Rlys.* and *Metro. of Paris*);

« use of asbestos base material (*Nor-* « *wegian Rlys*).

« To improve stabillity and comfort, « and reduce tyre wear, it is desirable « to *prevent hunting as far as possible.* « One way to achieve this is to avoid « longitudinal play in the direction of « the track between boxes and frame. « Very varied methods of doing this « have been used, which either reduce « the effects of rubbing or suppress it :

« adjustable or self-adjusting axle box « wedges used especially on steam loco- « motives;

« guides incorporating india rubber « fastened to the frame;

« axle box guides in the form of ver- « tical cylindrical pedestals sliding in « fitted cylinders (fig. 28, p. 1817/177, « August, 1950, *Bulletin*);

« axle boxes connected to frame by « rods and silent bloc bushes (fig. 25, « p. 1814/174, August, 1950, *Bulletin*) « a solution used on several Railways;

« boxes and frame connected by « laminated springs placed longitudinally « (fig. 30, p. 1826/186, of the August, « 1950, *Bulletin*) a variant of the pre- « ceding arrangement.

« 8. *Buckling springs* is generally « done hot. There is some extension in « Great Britain, and Switzerland, and « tests in France of the practice of « fitting the buckles on cold.

« *Spring steel* should be obtained « under such conditions that the same « heat treatment in the shops will pro- « duce constant results. This can be « got either by specifying the chemical « composition or by specifying given « characteristics to be obtained by a « predetermined heat treatment.

« *Coiled springs* should have their « surface free from defects. Some « Administrations (C. F. F., Norwegian « Railways) report fewer breakages with « springs of square and rectangular sec- « tion, than with round section bars.

« 9. *Rubber,* widely used on buffing « and drawgear is now being applied to « the spring gear and connecting mem- « bers between the body and frame of « tenders, electric locomotives, motor « coaches, railcars, and carriages.

QUESTION VI.

Comparative study of transmission systems between motors and axles of electric locomotives, electric motor coaches and Diesel-electric railcars.
Effect on the track of the types of bogies and systems of motor suspension.

SUMMARIES.

Introduction.

« The construction of railway rolling « stock in general and of motor vehicles « in particular is limited by:—

« *a*) the loading gauge;

« *b*) the permissible axle load;

« *c*) the materials available;

« *d*) the cost of construction;

« *e*) the cost of maintenance, inspec- « tion and repair;

« *f*) the maximum speed;

« *g*) the tractive effort.

« 1. *a*) There are a number of dif- « ferent transmission systems which can « be used for all speeds up to about « 150 km. per hour and for horse- « powers up to 1 500 per motored axle.

« *b*) Nose suspension inevitably « causes vertical and lateral shocks to « the track by reason of the unsprung « weight of the motor. The progressive « wear on rail and flange only aggravates « the trouble. It is desirable to under- « take trials for measuring the efforts « exerted on the track by different sys- « tems of suspension of the motors.

« *c*) Choice between the different sys- « tems of transmissions will be dictated « by local conditions :

« if the track is sufficiently robust and « well maintained, nose suspension may « be used without great disadvantage;

« if the track is weaker, it is desirable « to use one of the systems employing « resilient transmission and frame « mounted motors if possible.

« 2. In order to avoid severe shocks « to the track due to higher speeds, there « is a tendency to use on electric loco- « motives devices allowing transverse « movement either between the body « and the bogie, similar to those already « used on other types of stock, or even « between the axle and the bogie.

« On locomotives connecting devices « between bogies are tending to become « general in certain countries :

« *a*) in order to reduce side wear on « the track and flange wear, especially « on curves;

« *b*) in order to reduce hunting on « straight track.

« 3. The operating conditions with « steam and electric traction differ too « much from one another to permit a « reasonable comparison of track main- « tenance costs to be made.

SECTION III. — Working.

QUESTION VII.

Organizing methods to be used in large marshalling yards and terminals, to reduce to the minimum the cost per wagon shunted.

Determination of the staff and number of shunting engines needed;

Capacity and control of the efficiency of the marshalling yards;

Recording and numbertaking arrangements in the arrival and departure yards;

Statistics and traffic analysis by the control-room;

Braking and retarding arrangements;

The formation of trains for departure.

SUMMARIES.

I. General output of the yard.

1. Labelling wagons.

« The use by the sending station of « coded wagon labels showing the desti- « nation station and legible at a distance « facilitates, on railways of some import- « ance or with numerous lines, the work « of the yard staff and reduces the risk « of wagons going astray.

2. *Notification.*

« Preliminary notification of certain « details of the composition of incom- « ing trains enables the yard better to « estimate and organise its work.

3. *Timetables.*

« Though the timetables must be fixed « first of all in such a way as to ensure « the best forwarding arrangement for « the wagons and most satisfactory ser- « vices, they must also as far as possible « take into consideration the maximum « output of the yard, especially when « there are insufficient reception or « departure sidings.

4. *Allocation of sidings.*

« Careful allocation of the marshal- « ling sidings, based upon the layout of « the yard and the kinds of train to be « made up with the wagons shunted, has « produced good results on the turn- « over of the yard.

5. *Co-ordination and control of the operations of the yard. Use of equipment according to requirements.*

« Co-ordination of the different oper- « ations carried out in the yard is « essential for good output.

« This is assured in the first place by « the preparation of preliminary working « programmes or harmonograms show- « ing the way the different engines and « gangs of the various parts of the yard « are to be used in each shift.

« These programmes will particularly « provide for the carrying out of certain « preliminary operations to be done at « the same time and which are required « for shunting.

« At the same time, the concentration « of all useful data in the hands of « the yardmaster with the necessary « extensive telephonic communications « throughout the yard makes it possible « to carry out the programme to the « best possible extent.

« In order to carry out these meas- « ures, a « control post » appears to be « very desirable in large marshalling « yards, especially if these have several « independent yards.

Shunting engines.

« 6. The shunting engines used in « marshalling yards must be of a suit- « able type for the special work required « of them. The Diesel engine has prov- « ed its worth wherever it has been used, « from the point of view of having a « higher output and greater flexibility « than the steam locomotive.

« 7. In the case of steam locomotives, « it is necessary to take special steps to « minimise interruptions due to the « need to refuel or for maintenance « purposes. In almost every case it is « of value to install a fuelling point in

« the yard where water and coal can be « taken.

« 8. In principle the use of train « engines for shunting is not to be « recommended except in the case of « certain special operations of limited « importance.

« 9. The proper use of shunting « engines which is shown by the number « of wagons shunted per hour can lead « to considerable economies; it must be « watched from day to day by the « management of the yard and by the « « control post » dealt with under « summary No. 5.

II. Efficiency of the special operations carried out in the yard.

10. *Numbertaking.*

« Careful checking of wagons on « arrival and departure provides great « advantages. It is also recommended « that the numbertakers should prepare « cut cards and shunting lists. Finally, « certain regulations regarding the num- « bertaking should be of great use in « large yards.

11. *Wagon examination and repairs.*

« In general it is as well to make a « complete examination of the wagons « on the actual reception sidings so that « damaged wagons can be sent direct « to a special siding when they are « shunted; the second check before « departure is only to detect wagons « which may have been damaged while « in marshalling yards.

« In the large marshalling yards, cer- « tain sidings (the outer ones as a « general rule) can be usefully allocated « for very small repairs, provided that « the essential safety precautions are « taken.

Shunting.

« 12. The speed of shunting depends « upon the layout and the facilities pro- « vided, the prevailing weather condi- « tions (and, in some cases the compo- « sition of the train to be shunted). « These points being taken into account, « the speed selected should be the maxi- « mum speed which allows the wagons « to run into the marshalling sidings « with the greatest regularity and the « minimum of wrong shunts and over- « takings.

« 12 *a*). Installations where the shunt- « ing output can be increased contribute « to the reduction in cost per wagon « shunted. The majority of administra- « tions are of the opinion that retarders « are one of the best means to resolve « this problem.

« 13. The driver, the man in charge « of the hump, the pointsmen and all « the shunting staff should be in close « communication with each other by « visual and oral means, and also by « telecommunications.

« 14. The prevention of lost time and « accidents is of the greatest importance « from the point of view of the general « output of the yard. In particular, « care must be taken to reduce to the « minimum any interruptions to the « shunting, specially, by taking steps to « deal with the refuelling of the engines « on the site, the closing up of wagons

« in the sidings and the reduction in the « numbers of wrong shunts.

15. *Braking and skid braking.*

« Overtaking, rough shunts and « damage must be reduced to the abso- « lute minimum by suitable braking and « skid braking methods.

« In yards equipped with retarders the « best solution is generally :

« on the one hand, to reduce the « speed of the wagons by means of retar- « ders;

« on the other hand, to stop them « by means of hand operated skids in « the siding, immediately behind and as « near as possible to the last wagon « shunted.

« In yards not equipped with retarders « the spacing of the wagons is generally « carried out by special apparatus or « hand operated skids, which are thrown « clear of the rails; the wagons are stop- « ped at the end of the siding by hand « operated skids as in the previous case.

Train formations.

« 16. A general preliminary pro- « gramme for the making up of trains, « adapted to day-to-day requirements, « by the yard management, is extremely « desirable.

« 17. In most of the countries con- « sulted the making up of trains con- « veying traffic for more than one desti- « nation is left entirely to the yard staff. « It is, however, desirable to organise « this work on rational lines; with this « object in view, some countries have « already made use of « simultaneous « making up » which saves about 50 % « of the time previously required for this « operation.

III. Economies to be made when the number of wagons to be dealt with is less than the full capacity of the marshalling yards.

18. *Temporary reductions in traffic.*

« Temporary reductions in the move- « ment of traffic through marshalling « yards which are normally open con- « tinuously can, as a rule, be accom- « panied by important economies fol- « lowing the closure of the sorting and « formation sidings for not more than « 24 h. at the beginning of the week, « the periods of closure being staggered « to provide a few hours overlap.

19. *Permanent reduction in the traffic.*

« If there is a permanent falling off « in traffic, the necessary economies can « be obtained either by reducing the « shunting capacity by means of a « decrease in the number of men and « shunting engines employed, or by clos- « ing one or more parts of the yard for « one shift per day or even two in « exceptional cases. If the decline is « maintained or the traffic continues to « fall, it becomes necessary to recon- « sider the whole problem in the light « of traffic requirements in order to « determine the purpose which the yards « should serve in the general plan and « traffic movement.

IV. Staff.

20. *Training and selection of staff.*

« The high output of marshalling « yards depends to a very large extent

« on the professional skill and efficient « work of the staff employed.

« For this reason extensive profes- « sional instruction and the careful « selection of certain specialised staff, « in particular the skid brakesmen, has « been found to give excellent results « wherever it has been introduced.

« Careful selection of the supervisory « staff is also necessary.

21. *Output premiums.*

« Some railways have adopted with « success systems of incentive bonuses « which take into account the out- « put and quality of the day's work. « The majority of the Administrations « are in favour of this idea.

V. Comparison and general control of the results obtained.

22. *Factors influencing the output of the yards and comparative results.*

« The factors most likely to give a « measure of the output of a marshal- « ling yard are :

« *a*) the average time elapsing be- « tween the arrival of a wagon in the « yard and the time it is ready to leave;

« *b*) the number of wagons shunted « per shunting engine hour;

« *c*) the total number of men employ- « ed in the yard compared with the « number of wagons dealt with;

« *d*) percentage of wagons damaged « in relation to wagons shunted.

« It is, however, difficult to draw « comparison between one yard and « another and these factors are, there- « fore, only really useful for the purpose « of comparison between the output of « the same yard at different periods.

23. *General control of the results obtained.*

« Effective and constant control of « the work must be maintained at all « levels in order to keep up the effi- « ciency of the yard in all its phases. « This control, which is based on the « appropriate documents and statistics, « must above all make it possible to « adapt the different resources of the « yard and the train services to the « actual traffic requirements. »

QUESTION VIII.

In view of the ever increasing weight of road competition, what are the most appropriate measures, apart from reduced rates, for keeping traffic by full wagon loads in the hands of the railway ?

Would not road transport at the end of the railway journey be justified in order to get direct contact with clients who are not connected up by railway sidings ?

Should not the road vehicles required to assure such transport be attached to centre stations, equipped with suitable handling equipment, from which the road transport services would start ?

Choice of the vehicles to be used.

SUMMARIES.

« 1. Some railways consider that the « use of lorries for haulage services, by « extending their radius of action, now « makes it possible to concentrate the « traffic in a certain number of well « equipped station centres, by using

« motor haulage services over longer « distances, and that this organisation « will definitely lead to economies.

« But although many theoretical stu- « dies of this idea have been put for- « ward, it does not appear to have been « the object of practical trials, except in « the case of parcels traffic. It appears « very desirable that such trials should « be undertaken as soon as possible by « different railways and the results « published, so that everyone can profit « by their experience.

« 2. The general opinion appears to « be in any case that if the traffic is con- « centrated in this way in the station « centres and the haulage services « extended, it is necessary for the rail- « way to have control over such ser- « vices, if there is to be no risk of los- « ing the traffic at each end owing to « competition.

« 3. The attention of the Congress « should be drawn to the importance of « terminal transport as regards the cost « of transport between clients who are « not linked up with the railway. The « reduction in the cost of terminal « operations, whether they be in the « handling at stations or in the haulage « between the station and the premises « of the clients is of considerable impor- « tance, increasing when short distances « are involved.

« 4. Terminal transport can be pro- « vided by the railway itself, but regard « must be paid to the wishes of certain « traders to use either their own lorries « or lorries operated by a public haulage « firm.

« 5. Public road transport undertak- « ings, like the railways, have to protect « themselves against competition by « throughout transport in traders' own « vehicles, and in view of this, it should « be possible to reduce to the minimum « door-to-door costs.

« 6. Experience has shown the value « of the door-to-door technique which « is the essential advantage of the motor « vehicle. The oldest solution to the « problem on the railway is the private « siding. It would appear to be to the « interest of the railway to do all it can « to increase the number of such « sidings. Certain railways appear to « be in this respect much more ahead « than others. Some railways are pre- « pared to share in the capital costs of « providing private sidings on condition « that the traders concerned guarantee « an adequate volume of traffic.

« 7. When clients are not linked up « by private sidings, the railway does « not seem to have taken sufficient « interest to date in the other methods « which enable the door-to-door tech- « nique to be obtained, using the railway « for the main part of the journey. It « would appear advisable to make great « efforts in this direction.

« 8. This effort would involve not « only capital investment, but also com- « mercial organisation. Clients must « find available at the railway station all « the facilities obtained from its com- « petitors, and the railway should collect « and deliver goods just like the road « haulier. It is found that when the « railway confines itself to perfecting

« technical arrangements and informing « its clients about them, it does not get « any results. Experience in Great « Britain, from this point of view in con- « nection with door-to-door services, « shows in the clearest way the results « that can be obtained with a proper « commercial organisation.

« 9. A certain number of solutions « making door-to-door transport pos- « sible have been perfected : containers, « rail-road trailers, wagon-conveying- « trailers. It seems that up to date « experience does not warrant the « recommendation of one rather than « another of these solutions. The dif- « ferent railways should continue their « trials. It is not certain that a single « solution can solve all the problems « arising. In the end, it is the client « who is the best judge of what suits « him, and he should not be forced to « adopt one solution rather than another « when experience shows that they all « have their uses. It is necessary how- « ever, for economic operation, only to « have a small number of types of no « matter what solution adopted.

« 10. In addition, it seems essential « that the railway should so organise its « operation that the wagons used for the « transport of containers or rail-road « trailers should have a good user.

« 11. In the fight against competition, « the railway should not neglect other « improvements to its services capable « of inducing clients to choose it in pre- « ference to other methods of transport. « Safety, rapidity and regularity of trans- « port should all be increased. Time- « tables which enable the traffic to leave « and arrive at the most suitable hours « are of greater value than actual speed. « For example, there is no benefit in « saving a few hours on the transport « of food-stuffs if this saving will not « enable the trader to place his goods « on the market in good time.

« 12. The building of special wagons « adapted to special requirements is « another way of retaining railway traf- « fic. Opinion is divided concerning « the value of including such special « wagon in the ordinary stock or « encouraging the use of such wagons « provided by the clients or by private « undertakings from which they hire « them.

« 13. It is recommended that all faci- « lities should be provided at railway « stations which their size and layout « permit, for example, the letting of sites « and the provision of handling equip- « ment.

« 14. Finally, attention should be « drawn once again to the importance « of the general relationship of trans- « port, both public and private. It is « necessary to convince public opinion « that undue use of private transport for « traffic which pays best is contrary to « general economy. This not only « leaves public transport with the less « paying traffic but also reduces the « total traffic entrusted to it and in- « creases, in effect, the cost of transport « to the public as a whole.

« It is for the public authorities to « draw proper conclusions from this « statement of the situation. »

QUESTION IX.

Modern safety and signal installations (centralising apparatus for block system and signals). — Central electric apparatus with individual levers and « all relay » levers (all electric interlocking). — Automatic block-system with continuous current and coded current. — Light and speed signalling.

SUMMARIES.

I. Remote control and operation of points and signals by means of relays.

« 1. Except in North America where « special conditions obtain in that long « lengths of line have been operated on « the « Train Order » system, remote « control of signalling by means of a « coded relay system has not been used « to a very large extent.

« 2. A number of other railways « have, however, used the system to « some extent and intend to extend the « system as circumstances permit.

« 3. Remote control generally implies « the use of automatic block signalling « and this makes it possible to do away « with present safety measures.

« 4. The system has been employed « to increase the capacity of lines, to « secure economies in operating or to « bring about greater safety.

« 5. The financial result is generally « decided by the cost of the coded relay « equipment as against the cost of the « number of controlling circuits needed « for the required number of signalling « functions over the distance involved.

« 6. No special maintenance arrange- « ments have been found to be neces- « sary and there has been no particular « difficulty in obtaining suitable main- « tenance staff though special training is « required.

II. Electric power signalling installations. — Interlocked levers, relay interlocking, free push button or switch systems.

« 1. Though free push botton and « switch systems are being used to an « increasing extent certain administra- « tions consider that sufficient working « experience has not yet been obtained « to say whether such systems or the « well-tried power signalling systems « using miniature interlocked levers « would be preferred.

« 2. The advantage of the free push « button or switch system over levers « individually interlocked is above all, « of an operating character. Certain « administrations are specially of this « opinion when the system permits the « automatic setting up and cancellation « of routes.

« 3. It is not considered that greater « technical knowledge is required on the « part of the maintenance staff for main- « taining free push button or switch « systems than for interlocked lever « systems but proper training of the staff « is necessary owing to the much larger « number of circuits and relays asso- « ciated with push button and switch « systems.

« 4. There is little difference in the « overall prime cost of the different sys- « tems or in the cost of day to day

« maintenance. The number of relays « requiring periodical overhaul, how- « ever, is greater in the case of the push « button and switch systems.

« 5. It is considered that free push « button or switch systems give rise to « rather more serious and complicated « problems for the traffic department in « case of breakdown than with inter- « locked lever systems. This being so « it is necessary to design the system so « that a fault can be rectified quickly « such as by the use of plug-in relays.

« 6. Opinions as to whether push « buttons or switches should be fitted on « a geographical panel or a separate « desk panel are divided.

III. Automatic signalling. Track circuits using permanent current or coded current.

« 1. Coded current track circuits are « used fairly extensively in North Ame- « rica and to some extent in France and « in new installations in Italy. Some « experimental sections have been instal- « led on a few railways and the system « is under consideration by others.

« 2. Except where continuous cab « signalling is being contemplated, the « advantages claimed for the coded cur- « rent system do not appear to com- « pensate for the increased cost and « complication, except in special cases.

« 3. There is full confidence in the « correct operation of permanent current « track circuits and coded current cir- « cuits both from the point of safety and « regular operation.

« 4. It is not practicable to say what « maximum length of track circuit is « advisable as this depends upon several « variable factors such as ballast condi- « tions and type of rail fastenings.

« 5. The train shunt is governed by « the maximum variation in the ballast « resistance and by the minimum value « to which this falls. Under conditions « of maximum ballast resistance the « train shunt cannot be higher than the « minimum value to which the ballast « resistance falls. The train shunt is « therefore not governed by the length « of a track circuit alone. Consequently « actual train shunts for track circuits of « various lengths cannot be given as so « much depends upon other factors.

« 6. It is fairly general practice to lay « down a minimum value of resistance « for the track circuit test shunt below « which it should never fall. A different « minimum value is usually stipulated « for different types of track circuit but « except on a few of the railways the « lowest figure is 0.15 ohm. It is con- « sidered that this value is rather lower « than could be desired and considera- « tion should be given to the best means « of raising it in order to increase the « safety factor.

IV. Light signalling. Signalling for direction and speed.

« 1. The systems of light signalling « used by the different railways vary so « much and each railway, owing to the « amount of signalling already in use, is « so committed to its own system that « it would not be practicable to adopt « a uniform system for all railways even

« if a common system could be agreed « upon.

« 2. The majority of the railways use « a system of speed signalling, some of « them giving no indication of direction, « whilst others combine with their speed « signalling some indication of the route « to be taken.

« Other railways, notably the British, « do not have speed signalling, but use « a system of four simple running « aspects indicating danger, caution, « preliminary caution and clear, with a « direction indication at the home signal « at a diverging junction.

« 3. The opinion of the majority is « that it is desirable for a driver to « know at a junction whether the route « which he should take is correctly « set up.

« It is considered, in general, suffi- « cient that an indication of the direc- « tion should be given at the junction « home signal.

« 4. Although both the multi-lens type « and the type of colour light signal « with a moving vane with two or three « coloured glasses are used to a con- « siderable extent, it is considered, by « the majority of administrations, that « the advantage lies with the multi-lens « type.

« 5. With regard to lamp bulbs, the « single filament type is preferred as « with two filaments, however close « together they may be, they cannot « both be at the focus of the optical « system and the one out of focus gives « a reduced visibility which cannot « altogether be compensated by in- « creased power. Also both filaments « may be disconnected from the supply « at the same instant or failure of the « second filament may soon follow « failure of the first.

« 6. It is desirable for the lights of « controlled signals to be indicated in « the signal box and, at least for auto- « matic signals, for the lamp in the red « aspect to be proved alight before the « next signal in rear can assume a « proceed indication.

« 7. There should be no confusion « between red and yellow lights provided « that the colours chosen are distinct « and the lenses and glasses are obtained « to a strict specification within close « limits. No objection is therefore seen « to the use of a single yellow aspect by « itself or a single red aspect by itself.

« 8. On lines electrified on the over- « head system, it is preferable to adopt « colour light signalling. Nevertheless, « semaphore signalling can be retained « so long as the electric traction equip- « ment does not seriously impair the « visibility of the signals.

« 9. It is better from the point of « view of locating and sighting the « signals and to avoid vibration of the « light beam and damage to lamp fila- « ments to fix the signals on separate « posts rather than fix them to the « catenary structures.

« 10. Flashing lights are used by « several countries but for different « purposes.

General.

« 1. With one or two exceptions the « average number of breakdowns of all « kinds in automatic signalling sections « is less than one per signal per year. « This is considered to be a remarkable « result with the equipment concerned. « The number of failures prejudicial to « safety is practically negligeable.

« 2. Automatic signals may be passed « at danger under two systems:—

« *a*) only after receipt of a telephone « authorisation from a signal box or « station, and

« *b*) under certain rules without tele- « phone authorisation, the signals which « may be so passed being indicated in « some manner such as by a marker « light or other sign. »

SECTION IV. — General.

QUESTION X.

Drawing up the financial balances regarding passenger and goods services taking into account the prime cost of trains: per category, per line and per type of motive power.

Principles and methods of calculation.

SUMMARIES.

« 1. The use of an efficient system of « cost finding is still very limited among « the railways and often merely in an « experimental stage.

« 2. From the experience already « acquired by different railways, it « can be concluded that in the present « railway economic situation a workable « cost finding system including among « other things calculations of marginal « and average costs of trains per cate- « gory, per type of motive power, and « of financial balances regarding passen- « ger and goods services and different « lines of a railway system must be « considered to be of fundamental « importance for efficient railway man- « agement.

« 3. In broad outline, two different « systems of cost finding can be dis- « tinguished, « the accounting method » « and « the alternative budget method ». « A special variation of these two sys- « tems of cost finding is the method of « standard costs applied, for example, by « the Dutch Railways.

« The accounting method is primarily « based on an analysis of the expenses « of a past year, while the alternative « budget method involves an estimation « of the development of future expenses « and revenues. However, one can « distinguish different lines of develop- « ment as regards the accounting « method. At one extreme a very sche- « matic cost division between a few ser- « vice branches and at the other a very « detailed accounting analysis, at the « same time statistical, of the costs of « different categories of trains, traf- « fics, etc.

« According to the latter very complete variant of the accounting method, « the calculated costs of the base-year, « when applied to future time periods, « are readjusted to take into account « modifications in the economic condi- « tion, in the traffic characteristics, etc.

« In its most advanced form the « accounting method, as applied, i.e. in « France and in Belgium, will therefore « give the same results as the alternative « budget method.

« 4. A general system of cost finding « comprises as a basic element calcula- « tions of average and marginal costs of « different operating services (cost of « trains per category, per line and per « type of motive power, etc.) and of the « various categories of traffic services « (costs per passenger carried, per ton « forwarded, costs per passenger-kilo- « metre, per ton-kilometre, etc.). With « these costs as a basis one can form e. g. « the financial balances (profit and loss « statements regarding passenger and « goods services), which are the main « object of this report.

« 5. Profit and loss statements of « passenger and goods services are « valuable for attaining a rational busi- « ness policy of the railway enterprise « as regards the general level of fares « and rates of these two principal classes « of traffic. Moreover, the knowledge « of average costings, and of appropriate « marginal costs, may enable determina- « tion of particular rates and fares « applicable either to certain passenger « traffics or to certain goods traffics.

« 6. Profit and loss statements of dif- « ferent classes of traffic are used for « establishing « full cost » prices, which « the railways often apply to postal and « military transports, where the pay- « ments according to goverment's order « must be fixed on a « cost of service » « basis.

« In establishing profit and loss state- « ments of this kind, it is necessary to « separate even the common and « constant costs according to some « agreed method between the different « classes of traffic.

« 7. Profit and loss statements may « be prepared for a line or a group of « lines of a railway system. Statements « of this kind have been established by « various railways, particularly for « secondary lines.

« Such statements, that often will be « rather arbitrary and conventional as « regards calculation methods are never- « theless of great practical value as a « measure of the relative profitability of « different lines of a railway system. « Particularly for economically weak « lines these statements fulfil an import- « ant task in meeting, within reasonable « limits, the claims of certain interested « parties likely to exercice pressure.

« 8. In developing a national trans- « portation policy by the Government « and its different agencies, where the « most important problem will be to « create an economically rational co- « ordination between the different « means of transport, railways, high- « ways, waterways and airways, it is « necessary to have an adequate knowl- « edge of the comparative costs of « transport by each of these different « means.

« It is therefore desirable that cost « calculations and profit and loss state- « ments (financial balances) of the same « general character as those recom- « mended above for the railways, are « also introduced for highways, water- « ways, and airways. As to these latter « means of transport it is particularly « important to have the costs of the per- « manent way and the terminal facilities « clearly and distinctly accounted. »

QUESTION XI.

Organisation and development of medical and social services with partnership of the staff in their management.

SUMMARIES.

« 1. When the legislation of the « country does not make it impossible, « it is advantageous for the Railway « Administrations to organise their own « medical and social services in order « to meet the pressing requirements of « railway traffic as well as the particular « conditions of the work and welfare of « their staff.

« Moreover, when a country's medical « services are inadequate or non-exist- « ent, the Administration concerned « should itself organise such services for « its employees and their families.

« 2. Where there is complete or « limited autonomy of the medical and « social services vis-à-vis the general « legal regime, it is advantageous to let « the staff share in the management of « services providing social benefits, as « far as is permitted by the regulations « governing in each country the medical « and social activities on the railways.

« 3. Social services in particular « should be based on the concept of « solidarity and mutual assistance.

« 4. It is desirable that in every field « where it is practicable, contacts and « exchanges shall be organised between « the employees of the different Rail- « way Administrations. Where they « are already in existence (in the med- « ical field: International Union of « Railway Medical Services; in the « world of sport: International Rail- « waymen's Sporting Union; in the « tourist field: International Federation « of Railwaymen's Tourist Associations), « such contacts and exchanges should « be extended and developed, to include « those Administrations which so far « have not taken part in them.

« 5. Railway Administrations would « find it of value to organise instruc- « tional classes for employees to enable « their qualifying for higher posts.

« It is desirable that contacts and « exchanges between Railway Adminis- « trations, already recommended in « other connections, should also take « place in the field of professional educa- « tion and improvement.

QUESTION XII.

What must the importance and the prevailing conditions of traffic be, in order that from the economic point of view:

a) the construction of a railway line;

b) the keeping operating an existing railway line;

should be useful?

SUMMARIES.

Preamble.

« After examining the summary of

« the replies prepared by the Special « Reporter and the statement of facts « obtained by the Special Reporter, the « summaries which follow have been « framed solely from the view of eco- « nomic railway administration, omitting « consideration of other aspects.

« 1. For different areas there are « variations in regard to railway opera- « tion and maintenance, periodic traffic « fluctuations, transport organisation « and economic conditions. It is there- « fore in general not possible to state :

« *a*) the volume of traffic for which « a new line should be built;

« *b*) the volume of traffic below « which operation of an existing line « should be discontinued.

« 2. Each case of building a new line « or continued operation of an existing « line must therefore be considered on « its merits.

« 3. For these investigations each « railway system ought to be able to « assemble reliable and sufficiently « detailed data of receipts and expendi- « ture for each prospective new line and « for each existing line of doubtful « value.

« 4. In the interpretation of the data « so compiled, and in the formulation of « a sound commercial judgment of the « future position, attention must neces- « sarily be directed to the following « factors :

« *a*) the relation of the line to the « general traffic of the region and its « contributory value as a feeder to the « main line;

« *b*) the conditions of competition or « co-operation with the other means of « transport.

SECTION V. — Light Railways and Colonial Railways.

QUESTION XIII.

Modernisation of the maintenance methods of the permanent way on the light railways.

SUMMARIES.

« 1. The view is almost unanimous as « to the efficiency of systematic mainten- « ance; most of the systems have « replaced haphazard maintenance by « various methods of periodic overhaul :

« *a*) *General overhaul* of certain sec- « tions according to a programme, « accompanied by *partial repairs* on « some other parts of the system;

« *b*) *Complete overhaul* of certain « sections according to a programme « accompanied by a programme of « *reduced overhaul* of other sections « and by *partial repairs* elsewhere.

« 2. The lengths of the cycles of « repairs vary between 2 and 6 years « according to climatic conditions, and « the nature of the ballast, and are « dependent on the necessity for altering « the permanent way for new traffic « conditions.

« In cases where the length of the « cycle is 2 years the tendency is to try « to increase the length of the period.

« 3. The rails and sleepers on certain « sections are renewed annually.

« 4. Various satisfactory methods are « used for the conservation and con- « solidation of the material, in parti- « cular :

« restamping the fishplates or insert- « ing packings;

« welding rail joints and building up « the frogs of crossings;

« re-using damaged holes in the slee- « pers by using wooden pegs and drilling « the pegs, or by using packings or « wedges;

« conserving the bearing surfaces by « the use of sole plates or wooden bear- « ing plates;

« binding split sleepers;

« maintaining the gauge on curves of « small radius by the use of wedges, « stops, plates, cleats or ties.

« 5. Measured packing is technically « superior to hand tamping in the case « of small lifts : it is more economical « (the output per man is at least doub- « led) provided skilled, conscientious « permanent staff are available and pro- « vided also that the cost of chippings « delivered to the site is not prohibitive.

« Measured packing cannot be applied « where large lifts are made. In this « case mechanical tamping, preferably « with large machines (compression and « vibration), followed by the use of « sighting boards, is recommended.

« The correction of the alignment by « the versine method with a calculation « of the errors and marking the correct « position, used by many railways « (sometimes with the assistance of a « calculating machine) makes it possible « to get regular curves without proceed- « ing by trial and error on the site.

« 7. Chemical weed-killing is replac- « ing hand weeding on most railways; « the most usual weedkiller is chlorate « of soda in solution in water, or pure, « or mixed with other salts. Never- « theless in tropical regions this process « is ineffective due to the high rainfall « and flame throwers are substituted in « some cases.

« All the railways prepare mainten- « ance programmes and check the way « these are carried out by preparing « graphs or tables.

« 9. The question of replacing small « gangs by larger gangs maintaining « longer lengths and the problems of « lodging and transport of personnel « must be considered specially in every « case. The organisation of large gangs « generally permits an overall reduction « of manpower.

« 10. The introduction of bonuses « does in fact provide an incentive in « practice. It is difficult to establish « the basis on which such bonuses « should be based. This problem is « now the subject of studies in several « countries.

« 11. The general tendency is to « mechanise tools and equipment and « this considerably increase output. In « certain colonies besides, mechanisa- « tion is essential in order to conserve « manpower. Mechanisation does not « necessitate specially skilled manpower.

QUESTION XIV.

Change-over from steam-locomotive traction to Diesel traction.

SUMMARIES.

A. Train locomotives.

« 1. Diesel train locomotives have « already, from the technical point of « view, been sufficiently perfected for « use in the normal railway services with « a degree of safety and regularity com- « parable in practice to that given by « the steam locomotive.

« 2. It is possible with Diesel loco- « motives to use several single units « coupled together, driven by one man. « In practice up to the present time it « has been found preferable to employ « at least two men per train.

« For standard gauge railways the « most usual size unit is from 1 000 to « 2 000 HP and on narrow gauges from « 600 to 1 500 HP.

« 3. The most important factor to be « considered however is the economic « side, which is greatly influenced by « the high purchase price and higher « amortisation charges, which can, how- « ever, be compensated by a very high « utilisation coefficient, but above all by « the price of fuel which varies consid- « erably from one country to another.

« This latter reason and the special « characteristics of the services to be « operated and the countries in which « they are run, are today the funda- « mental factors which can lead to a « widely different development of Diesel « traction, both as regards its import- « ance, and the constructional types.

« 4. In the United States of America « the construction of steam locomotives « had practically been given up in recent « years in favour of Diesels. In some « African and Colonial countries, the « local conditons are particularly fa- « vourable to the development of « this method of traction; in other coun- « tries, especially in Europe, the question « has not developed any definite tenden- « cies to date.

B. Shunting locomotives.

« 5. Diesel shunting engines can be « divided into three categories as regards « power, according to the work for « which they are designed :

« *a*) 50 to 100 HP for shunting « vehicles and engines in the sheds, « shops and small stations;

« *b*) 150 to 300 HP for shunting in « the average sized stations;

« *c*) 400 to 700 HP for heavy shunt- « ing operations and for use in the large « marshalling yards.

« 6. It would appear that in practice « the tendency is to standardise the use « of Diesel shunting locomotives on all « administrations whatever their import- « ance and nature.

« 7. For the types of the 3rd cate- « gory Diesel locomotives with electric « drive are generally used, though this « does not exclude the hydraulic drive; « in the case of the other two categories « mechanical drive seems to be most « widely used in view of the particularly « favourable cost price, whereas the

« electric and hydraulic drives are more « flexible in service.

« Below 500 HP the tendency is to « adopt mechanical transmissions with « torque convertors.

« 8. The coefficients of availability « and utilisation of Diesel shunting « engines are higher than those for « steam traction, whilst the operating « costs are definitely lower.

« 9. The use of light Diesel locomo- « tives is particularly indicated from the « point of view of economy, to replace « steam locomotives for light or inter- « mittent shunting operations.

« In the case of light railways light « Diesel locomotives are normally used « on goods trains, in which case they « carry out the associated shunting « operations — and on local passenger « trains.

C. **Railcars.**

« 10. In European countries railcars « are used for passenger services on « secondary lines and even for fast long « distance services on main lines.

« In the United States, railcars seem « to be used to a very limited extent on « secondary lines and their development « does not appear to be likely.

« In Europe, it should be noted that « it is during recent years that the use « of railcars has increased to such a « rapid extent, and it appears likely that « this development will continue owing « to the favour it finds with the public « and the operating advantages obtained, « especially the flexibility and increase « in the average speeds — above all on « lines with heavy gradients or many « stops.

« In non-European countries, the use « of railcars is often justified by reasons « similar to those already mentioned in « connection with Diesel train locomo- « tives.

« 11. According to the type of ser- « vice, two categories of railcars can be « distinguished, i. e. the light type for « economic services at moderate speeds, « with a high degree of user, and the « other for important services at higher « speeds, with a greater specific power « (10 and even 13 HP per ton) and « offering greater comfort.

« 12. Mechanised and hydraulic « transmissions are adopted most fre- « quently in modern practice.

« 13. The use of trailers, as well as « coupling up in multiple units, is the « general practice with the most recent « types. Generally single control by « one man is realised, and it is possible « to pass from one unit to the other; « the use of articulated rakes does not « seem likely to develop on the same « scale.

« 14. The use of adhesion railcars has « proved satisfactory even on lines with « very heavy gradients.

« 15. The maximum advantages of « Diesel traction are realised when this « form of motive power is introduced « over entire sections of a system, both « in the case of train locomotives and « shunting locomotives, and also in the « case of railcars.

QUESTION XV.

Signalling on single track lines.

SUMMARIES.

« 1. Lines of small importance carrying a light regular traffic can very well « dispense with single line signalling. « Crossings of trains taking place at « definite points laid down in advance, « or according to pre-established regula- « tions.

« 2. Lines lending themselves to be « worked with a shuttle service use the « ordinary plain trainstaff.

« 3. Lines carrying a more important « and relatively irregular traffic, in admi- « nistrations where personnel are sta- « tioned at the crossing points, have « usefully had recourse to electric token « instruments. This system gives the « degree of safety required. It is more- « over of simple design and robust con- « struction.

« 4. Lines where there is considerable « traffic and overall speed is high tend « to adopt automatic signalling. When « a line is laid on its own inaccessible « right of way, track circuits are used. « If it is laid alongside or in the road- « way itself, i. e. if it has the character « of a tramway line, it becomes neces- « sary to use special circuits and over- « head contact makers, or « trolley « contactors ». It is in any case useful « to arrange for repeating lights, as this « increases the safety of operation.

« 5. *a*) The majority of lines are « agreed in not permitting, under normal « conditions, more than one train at a « time on a single line section;

« *b*) All Administrations are agreed « that setting back should be forbidden « as far as ordinary trains are concerned.

« 6. On those lines where the traffic « is regulated by telephone or telegraph, « the signals used appear to be those « controlling the stations themselves « rather than the actual single line. In « consequence they are outside the « scope of the matter under discussion « in this statement.

« 7. Telephone and telegraph work- « ing under the control of staff located « at fixed points along the line (traffic « controllers or regulators, stationmas- « ters) allows of dealing easily and « quickly with any unexpected situation « that may arise. It is conceivable that « it will continue to be used where it is « necessary to employ stationmasters.

« 8. Certain systems have made use « of radiotelegraphic communication « between control personnel and train « guards. This system which is still in « the experimental stage has given com- « plete satisfaction and would definitely « appear to have future possibilities. »

NEW BOOKS AND PUBLICATIONS.

[**656** (02)]

LAMALLE (Ulysse), Ingénieur civil des Mines-A. I. Lg., Directeur Général honoraire de la Société Nationale des Chemins de fei belges, Membre d'honneur de l'Association Internationale du Congrès des Chemins de fer. — **Cours d'exploitation des Chemins de fer.** — *(Railway Operating Course)*. — Volume I : *Exploitation commerciale. Principes tarifaires. Utilité maximum. Prix de revient. Concurrence.* 4th edition. — One volume (8 1/4 × 10 1/2 in.) of 208 pages and 74 figures. — 1950, Louvain, Librairie Universitaire, Ch. Uystpruyst, editor, 10, rue de la Monnaie, and Paris, Dunod, editor, 92, rue Bonaparte.

When the third edition of this work was published in 1934 the economic depression which started about 1930 was affecting railway traffic. To this was added the effects of continuously increasing road competition. Water competition, an older rival of the Railway, was also exercising its effects.

The author in developing his subject did not overlook this new situation. In this fourth edition, which has appeared at a time when circumstances are even less favourable to the Railway, he has gone back to — and insisted upon — an examination of the respective positions of the different methods of transport. There is now a fourth subtitle on the cover : Competition, added to those whose title is sufficiently explanatory; Rating principles; Maximum utility; Cost. The study of these various points of the programme will naturally lead to instructive comparisons.

An analysis of the legislation affecting railway transport makes it clear that the various forms of transport are not treated alike as regards obligations and responsibilities. The Belgian law, dating from 1891 and based upon the monopoly which the Railway then enjoyed, contains clauses which can only be justified in the case of a privileged undertaking. There are no such burdens upon road or water transport.

As regards the rates, the ideas reported which cover the whole of this question, are naturally supported by the most recent Belgian practice. Here again the discrimination shown in the treatment of the different forms of transport is apparent.

The strict obligations imposed upon the Railway contrast with the complete liberty enjoyed by the other methods of transport. The rates of the former, in addition to having to carry any traffic offered, are based upon the value of the goods.

One of the essentials of commercial operation is to strive after the best possible utilisation of available resources. To what extent is it useful to the public; what should be its limits of action; what are the obstacles in its way? These questions with others are elucidated in the chapter entitled : The usefulness of the Railway. This is political economy in its best sense, since if transport is not in itself a source of wealth, it is a powerful aid in its production and distribution. This study brings out the importance of the idea of partial costs and the effects of the multiplication of taxes.

Preoccupations of a financial nature also influence the three chapters entitled : Financial management of a Railway. Costs, and Operating Results. Their justification lies in the desire to achieve a satisfactory management which reacts upon the whole organisation, and in the necessity for controlling the working of the undertaking.

In the article on costs, the reader will appreciate, together with the method of calculating the general average costs of the passenger-kilometre and tonne-kilometre, the very extensive study of the allocation

of the indirect costs of operating expenditure and financial charges. The investigation has been followed right through to the final results and based upon the figures of the Belgian National Railways for the year 1945. A new method instituted by the Belgian National Railways (S. N. C. B.), the bases of which are explained, endeavours to deal with the problem more closely by trying to ascertain the standard costs rather than the actual figures. This has been applied to three recent years by the S. N. C. B.

The statistics of the S. N. C. B. have also been used to give numerical examples to support the discussion on the way the operating results should be taken and the data to be learnt therefrom.

In Chapter X, the competition from water transport and motor transport is examined under its multiple aspects.

Finally in Chapter XI, the author deals with the present position as regards the question of co-ordinating inland transport.

This rapid sketch only gives a very incomplete idea of a very important work. It gives one the impression of overflowing the limits which its author has set for it.

The doctrinal report is very happily set in the middle of carefully selected concrete facts. Although it is a first class work of reference for students, it can also be recommended not only to all those concerned with the operation of a Railway but to everyone who is interested in the question of transport, from no matter what point of view.

E. M.

[**385** (494)]

MATHYS (E.), former librarian of the Swiss Federal Railways, and MATHYS (H.), former official of the Rating Department of the Swiss Federal Railways. — **10 000 Auskünfte über die Schweizerischen Eisenbahnen** *(*10 000 *facts about the Swiss Railways)*. — One volume (6 × 8 1/2 in.) of 222 pages with illustrations and inset plates. — 1949, Bern, edited by the authors. (Price : 8.50 Swiss Francs.)

In offering this book to the public, the authors desired that it should benefit from their researches into the documentation to which their jobs gave them access.

M. E. MATHYS had already written two very noteworthy books which were reviewed in the *Bulletin :* « The Swiss Railways during the century 1841-1941 » and « Men of the Railways 1847-1947 ». The second edition of the former work has been out of print for a long time, and the present work is a new edition which has been revised and augmented to include events which have happened since 1941, so that it has become a much larger book and the new title is justified.

In Switzerland, a great many books are published about the railway. The abundance and variety of these publications is due to many reasons, amongst which mention must be made of the administrative organisation of the country, the economic and financial conditions under which the lines were built, the fact that they are often of a special character, the position of the country through which various international lines run, and modifications in the statute relating to undertakings.

To guide the enquirer into this vast mosaic of writings, as the authors call it, it is a good thing to give him a practical repertory. This contains the most important dates of construction, the technical progress and interesting facts concerning the management and operation of the railway).

To give some idea of the scope of the work, we may mention that in the chapter on Railway legislation are included the laws, decrees and ordinances, the interna-

tional conventions and agreements, public subsidies, concessions granted to private Railways as well as aerial Railways and trolleybuses (more than 200 concessions have been granted since the creation of the Railway).

Other chapters deal with questions of construction, operation, traffic and rates, organisation, nationalisation, and staff questions.

The Swiss public is not the only party interested in the information contained in this book. Amongst the international conventions, mention is made of the creation of the Standardised Railway Technique, the agreement concerning the transport of goods (C. I. M.) and the transport of passengers and luggage (C. I. V.), the agreement about wagons (R. I. V.) and that about coaches (R. I. C.), and conferences on timetables. Nor have the Railway Congress Sessions of Bern (1910) and Lucerne (1947) been forgotten.

The authors in this work have made a valuable contribution to the spread of knowledge concerning transport by rail. They have provided an invaluable aid to all those who wish to carry out researches into either the technical, economic or administrative side.

E. M.

[**656** (02)]

WAIS (Francisco), Ingénieur des Chaussées, Sous-Directeur du Réseau National des Chemins de fer espagnols. — **Compendio de explotacion tecnica de ferrocarriles.** *(Compendium of the technical operation of railways)* 2nd edition, revised and augmented. — One volume (6 1/2 × 9 1/4 in.) of 502 pages, with 409 illustrations. — 1949, Barcelona and Madrid, Editorial Labor, S. A.

The size of this book might give rise to astonishment at its title which evokes the idea of a synthesis. The formula *Technical operation,* at least according to the ideas of most French writers, merely covers part of the multiple activities of a railway. But in this case the expression is taken in a much wider sense. A glance at the table of contents shows that the work covers both the fixed installations and rolling stock as well as their use by the train services.

It will then be understood that the author has intended his report to be an investigation into all the essential factors. The reader will appreciate the advantage of having a complete general view of a Railway in a single book. It will enable the railway operator properly so called to penetrate as far as is useful into the domain of the other departments.

As for the permanent way, rolling stock and traction specialists, they will be able to find in this book much data of immediate practical use, without having to refer to other more extensive works. We may mention for example, in the construction of the permanent way, the cross-section, the quality of rail steels, the study of the progressive transitions between curves and straight sections; in the case of the rolling stock, the stresses allowed in axles and the pressures on the journals, the dimensions of the drawbar, a diagram of a bogie, the formulae used to calculate train resistances and the locomotive power required.

The book is divided into two parts. The first which contains ten chapters deals with the permanent way, the stations, the rolling stock and the signals. The second consists of 9 chapters covering the making up and running of the trains, the block system, telecommunication and dispatching. Centralised traffic control (C. T. C.) is linked up with the signalling. The organisation of the trains and the administrative organisation are the subject of a dissertation in which American methods are com-

pared with the structure of the European Railways.

In the final chapter the author explains how the operating results are recorded and how they should be taken.

In the various chapters many applications and new methods are explored. The maintenance of the permanent way benefits from the up to date equipment which makes it possible to renew the track by pre-assembled sections. Plans of passenger carriages and diagrams and photogravures of powerful streamlined locomotives stress the modern tendencies.

Apart from other considerations the fact that there is a programme in Spain covering the electrification of 4 500 km (2 790 miles) of line using 3 000 V D. C. current amply justifies the special chapter devoted to electric traction. The author discusses the choice of current, mercury converters, overhead lines, transmission and types of locomotives, and gives the characteristics of the Spanish locomotives and rail motor coaches.

For the new methods of traction (Diesel and gas-turbine) the author reserves a place justified by the remarkable results obtained, but besides their undoubted advantages he also discusses their inevitable drawbacks.

In marshalling yards, mechanical brakes and efficient lighting of the groups of sidings make it possible to speed up the work and cut down damage.

As regards signalling, colour light signals are replacing mechanical signals. The working of the points and signals by fluid has been replaced by a purely electrical system.

The latest developments as regards cab signals are : the continuous induction method (American automatic train control), based on the automatic block system and giving constant repetition of the permanent way signals on the locomotive. In the case of the automatic block the application of colour light signals already installed or proposed are described.

The relatively long chapter dealing with the telegraph and telephone installations is followed by another describing telephone equipment making use of selective calls. The latter are used in connection with the train running in the case of the dispatching system.

In an appendix entitled : Example of the calculation of short rails, the author gives tables based on the basic theory showing the number of short rails to be inserted in the inner line of rails and their order for different lengths of rails and radius of curvature.

This appendix refers to the first chapter dealing with the permanent way. Amongst other subjects, this deals with the calculation of the maximum speed permissible when the superelevation does not reach the theoretical value, the method of correcting curves by the versine method, a method of progressive transitions with varying superelevation following an S curve. We mention these details to support the opinion we expressed above on the value of this book for all technicians.

E. M.

ERRATUM

Bulletin for July 1950.

Report by Mr. E. J. F. Derijckere.

(Question IX, Rome Congress, 1950).

Pages 853/17 and 854/18 :

Under paragraphs 3, 4, 5 and 6, please read *40 km/h* (25 m.p.h.) instead of 45 km/h (28 m.p.h.).

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1)

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

(NOVEMBER 1950)

016. 385. (02]

I. — BOOKS.

In French.

1949 721 .1 (02

[C]AQUOT (A.) et KÉRISEL (J.).

Traité de Mécanique des Sols.

Paris, Gauthier-Villars, éditeur. 1 volume (16 × 25 cm) [d]e 296 pages, avec 150 figures. (Prix : 1 800 fr. fr.)

1949 385 .(09 .3 (494)

Les Chemins de fer suisses après un siècle, 1847-1947.

Ouvrage commémoratif (en 5 volumes) du Département fédéral des Postes et des Chemins de fer avec le concours des Chemins de fer suisses, publié sous la direction [d]e René THIESSING et Maurice PASCHOUD.

Tome premier : **Généralités, Histoire, Finances, Statistique, Personnel.**

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WIDMAN. — Les **ouvrages en béton précontraint** de la Région du Nord de la S. N. C. F. (3 000 mots & fig.)

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CAZAUD (R.). — La **résistance à la fatigue des aciers.** (6 000 mots, tableaux & fig.)

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WENDT (O.). — Die **« Thermit »-Schienenschweissung** bei der Deutschen Bundesbahn. (6000 Wörter & Abb.)

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AURNHAMMER (G.). — **Brückenbau in Betriebsgleisen.** (3 600 Wörter & Abb.)

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WINZLER (W.). — Die **neue britische Schiene der Regelform.** (1 000 Wörter & Abb.)

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949 **691** (493)
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949 **621** .438 (42)
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KARMALSKY (V.). — **Welded bridges** in New South ıles, Australia. (3 500 words & fig.)

949 **625** .232 (42)
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Big tunnel-lining job fully mechanized. (1 000 words & fig.)

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CHARLET (A. L.). — **Circuitos de via de corriente ntinua.** (10 000 palabras, tablas & fig.)

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